



***DELIVERABLE 1***  
***“COMPARISON OF WASTE MANAGEMENT  
SYSTEMS IN WESTERN AND TRANSITION  
ECONOMIES“***

**“Waste management in transition economies”**

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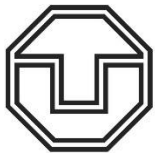
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## List of abbreviations

AIS	Automatized information system
BSSR	Byelorussian Soviet Socialist Republic
CDIAC	Carbon Dioxide Information Analysis Center
EBRD	European Bank for Reconstruction and Development
EPR	Extended producer responsibility
EU	European union
EurAsEC	Eurasian Economic Community
GDP	Gross Domestic Product
HBC	Housing building cooperatives
HPU	Housing and public utilities
JSC	Joint stock company
ME	Ministry of energy
MES	Ministry of emergency situations
MHPU	Ministry of housing and public utilities
MI	Ministry of Industry
MNREP	Ministry of natural resources and environmental protection
MT	Ministry of trade
MPC	Maximum permissible concentration
MSW	Municipal solid waste
MUE	Municipal unitary enterprise
NGO	Non-governmental organization
POPs	Persistent organic pollutants
RD of HPU	Regional department of housing and public utilities
R&D	Research and development
RSFSR	Russian Soviet Federative Socialist Republic
SAE	Special automobile enterprise
SME	Small and medium enterprises
SRM	Secondary raw materials
SUE	State Unitary Enterprise
SU	State union
UNDP	United nations development programme
UNFCCC	United Nations Framework Convention on Climate Change
UN	United nations
USSR	Union of Soviet Socialist Republics
WIP	Waste Incineration Plant
WM	Waste management
WTP	Waste treatment plant

## 1. Introduction

The designation of waste management is younger than the origin and handling itself. Even before our calculations, people learned to store their waste outside settlements. In this case, the term "waste" means "foodstuffs", bones or destroyed household items. From today's point of view, it can only be assumed that the deposition of the settlements served as protection against stench and animals. Also in antiquity in Europe and Asia metropolises the waste was deposited outside in clay vases. Partially, pits were filled with waste and faeces, then emptied, cleaned and then used again.

The first connections between hygiene, bad water, spoiled food, and epidemics were found by Hippocrates (c. 400 BC) and Avicenna (c. 1000 AD). [1]

The knowledge from antiquity around the concept of hygiene was lost with the end of the Roman Empire and the subsequent migration of people. There was a breakthrough in this area between the years 1850 and 1890. The doctors and scientists Ignaz Semmelweis, Thilenius, Louis Pasteur and Robert Koch first showed bacteria and viruses as pathogens. Furthermore, their distribution routes were reduced as a function of hygiene. In the following years, the connection between hygiene and mortality was recognized. This problem and steadily increasing amounts of waste demand the development of technologies for the treatment of waste. As early as 1876 the first waste incineration plant was built in England. [1]

Since the turn of the century the energy from waste incineration plants was used and household waste was recycled. Further development of waste disposal also involved environmental problems. For example regarding landfilling, it comes to groundwater pollution and gas emissions, pollutant emissions by waste incineration and compost with heavy metal loads. The steady increase in the population, the change and expansion of waste types, and the associated increase in waste volumes are dramatic environmental impacts over the years. A rethinking of waste disposal to the prevention and recycling of waste is taking place. The treatment of the waste goes away from the landfilling and towards recycling, incineration and composting. This change is strongly influenced by the development of countries in terms of policy, financial opportunities and preparedness of the population. For these reasons, there are large differences in the treatment of waste in different countries. [1]

In the course of this work, waste management systems are first described in post-socialistic EU countries, "old" EU states and the post-Soviet states, and subsequently compared with each other by indicators of waste management. In that case, the years 1995 and 2014 are in focus. They are compared concerning waste collection, waste treatment, landfilling, recycling, composting and incinerated waste per capita. Furthermore, the impact of unemployment and GDP per capita is considered.

The aim of the thesis is to show how and for what reasons the post-socialist EU states and "old" EU countries developed much better than the post-Soviet states, from a waste management point of view. Over the period from 1995 to 2014, the post-socialistic EU states and the Soviet states had the same requirements in the beginning. However, the waste management systems differ significantly.



## 2. Development of Waste Management in post- socialistic EU- States in the last 30 years

### 2.1 Overall Background

For the development of waste management in post-socialist EU-states, Poland, the former German Democratic Republic (GDR) and Estonia will be considered. A comparison of the countries' different approaches follows subsequently.

### 2.2 Legal and institutional framework of waste management

To be a member of the European Union, some essential requirements regarding waste management must be met. Poland, Germany and Estonia are EU member states, but there exist differences regarding the legislation of waste management. Despite the fact that each of these countries has a history in socialism, waste management and the corresponding legislation developed for each at a different speed.

In 1972, former East Germany was the first to pass a bill regarding the removal of waste. This was the first time the notion of "waste" and the law's scope of application were defined. Waste had to be removed so that the common good was not impaired.

In 1980, a regulation targeting the encompassing use of secondary raw materials formed the working standard of the collections plants (German: Erfassungsbetriebe) SERO and MAB. [5]

Following the reunification of the German Democratic Republic and the Federal Republic of Germany (FRG) in 1990, many laws regarding waste management were passed.

In 2005, Germany passed the Landfill Ordinance (German: Deponieverordnung) that sets prerequisites for the disposal of waste. The Closed Substance Cycle Waste Management Act (German: Kreislaufwirtschaftsgesetz) explains not only the notion of waste, but also its treatment. The following waste hierarchy is recommended:

- waste avoidance
- reuse
- recycling
- other utilisation (energetic)
- waste removal

The focus lies on waste avoidance, yet the best option in terms of environmental protection has to be chosen. In addition, ecological factors, the technical, economical and social implementations and consequences have to be considered. A distinct registration of waste flows is indispensable in order to meet the quality demands of a material recycling.

The legal establishment of product stewardship defines responsibilities along the product life cycle. This incentivises the development of products that produce as little waste as possible. Product stewardship should also ensure the environmentally friendly reutilisation and removal after use.

The Estonian waste policy meets basically the criteria of the EU-legislation. Hazardous waste makes up the majority of Estonian waste – that is why most changes apply to this sector.

In 1992, Estonia passed its Waste Act (German: Rahmenabfallgesetz), which regulated for the first time goals and principles of waste policy.

The former Polish People's Republic (PLR) recognized the environmental impact of industrialisation, urbanisation and technological progress already in 1968 as a problem of national importance. The Polish government started elaborating its own regulation for environmental protection and added the new rules in 1976 to the constitution. Among other things, the regulation covers a guarantee for the protection and the sustainable management of the environment. No changes were made in the environmental sector until 1989. To fulfil the requirements of the European Union, the first Waste Act was introduced in 1998. Another Waste Act was passed in 2001 and recommended the following waste hierarchy:

- avoiding waste
- reusing waste
- recycling and composting of waste
- utilization of waste by burning it as a source of energy
- depositing waste on landfills

In order to join the European Union, the Polish Republic became obligated to align its Waste Act with the requirements of the European Union. The long-term objective of the European Union is to avoid waste and to integrate recycling into the society.

In 1992, Estonia defined its Waste Act, which set objectives and principles of the Estonian waste policy. The Estonian waste policy meets the overall criteria of EU-legislation and

the legal situation in Estonia conforms partly to EU community rules or is even stricter. From 2002 until 2007 the first Estonian Waste Management Plan was in effect. It dealt with the preparation and realisation of the EU waste legislation. The second national Waste Management Plan was in effect from 2008 until 2013. It had the objective to separate biodegradable waste from mixed waste and the detour of waste from landfills. The ensuing Waste Act passed the ban on the disposal of untreated waste. In addition to the EU rules, Estonia pursued own objectives regarding reduction, landfilling and recycling.

### **2.3 Waste management situation**

Due to the economy of scarcity in the former GDR, secondary raw materials were acquired through the waste industry. The secondary raw materials were collected by the combines SERO and MAB. The combine SERO was specialized in any non-metallic raw materials and the combine MAB was specialized in any metallic material. Both plants received their secondary raw materials from citizens and institutions, who were motivated to collect secondary raw materials in return for a small monetary compensation. The waste materials could be handed over at disposal points, containers and collection points.

Waste materials that could not be used as secondary raw materials usually ended up on landfills. On a smaller scale, composting and incineration also played a role in the GDR's waste management. However, composting was important not for reasons of waste salvage, but because there was a lack of organic fertilisers. Until the end of the GDR there were only three experimental plants for composting that closed in 1990.

Incineration was also hardly in use. Until 1990 there were 36 incineration plants in the GDR that lacked the technical standards of West Germany – for instance, a typical flue gas cleaning was not applied.

The main form of disposal was to put municipal solid waste on landfills. In 1990, there were circa 120 authorised landfills, circa 1000 controlled landfills and circa 10.000 illegal dumps. At that time, there was no waste pre-treatment at all, yet hazardous waste underwent pyrolysis. Upon building a new landfill, there were no on-site inspections and there were rarely any base and surface sealings.

Another problem was at that time that existing landfills or illegal dumps were at some point legalised, but still not sufficiently renovated.

After the German unification in 1990, the planned economy of the GDR collapsed. This went along with a decline in collecting, processing and sales of the combines.

With the introduction of market economy, conditions changed for the combines. It was no longer necessary for citizens and the economy to collect waste material, because there were now enough primary raw materials available. There was also a lack of funds to pay for the collected raw materials and more and more disposal points closed. The remaining SERO collection plants were sold off to private entrepreneurs.

Germany slowly started to build up the Dual System Germany Ltd (German: Duales System Deutschland GmbH, short: DSD). In 1993, the Technical Instruction on Municipal Solid Waste (German: Technische Anleitung Siedlungsabfall, short: TASI) was passed, which presented a new guideline for the tipping of municipal solid waste. In order to meet the new guidelines, disposal companies, plant operators and other participants were given a reasonable amount of time for adaption. New treatment plants for the treatment of waste were opened and older landfills were closed or renovated according to modern standards. Since 2005 Germany bans the tipping of biodegradable waste on landfills.

In comparison, Poland accumulates annually circa twelve million tons of waste, which puts the country in sixth rank within the European Union. Yet there are estimations that circa two million tons of waste are dumped illegally.

The majority of Polish waste was put on landfills. After joining the European Union, the amount of biodegradable waste on landfills had to be reduced in order to meet the requirements of the European Union. The amount of biodegradable waste on landfills was supposed to be reduced by 25 per cent from 1995 to 2010, by 50 per cent until 2013 and by 65 per cent by 2020. However, Poland failed to meet the requirements in 2010. Including composting, the recycling rate rose from 6 per cent in 2001 up to 21 per cent in 2010. Alternatives were needed in order to meet the requirements of the European Union and the continuously rising recycling rates. Yet the focus of Polish waste policy was still on waste avoidance.

In 2010, there existed 85 composting plants, four fermentation plants and nine mechanical and biological sewage treatment plants for the treatment of waste in Poland. Until the year 2015 there existed only one refuse incinerator for pyrolysis, six more are currently under construction and could incinerate a total of one million tons of waste (as of 2015). In addition, 61 authorised landfills were closed and the Polish government started to renovate 527 legal landfills to meet the standards of the European Union.

The Estonian waste management system is tied very closely to the legislation of the European Union, but shows also own initiatives and guidelines. In order to prepare for the legislation and guidelines of the European Union, Estonia developed its own waste management plan, which was a requirement from 2002 until 2007 to transpose the European waste management act. This forced the communes to take on more responsibility and to deal with their budget for staff and financing more independently in order to achieve positive innovations for the waste industry.

The ensuing waste management plan was valid from 2008 until 2013. It required a separated collection of biodegradable waste and mixed waste. Furthermore, it emphasized the reduction of biodegradable waste on landfills in favour of composting and pre-treatment of biodegradable waste.

The introduction of the Waste in Act in 2004 banned the tipping of untreated waste on landfills. This was followed by investments in composting plants, refuse incinerators, mechanical-biological plants and the modernisation of landfills. The projects were financed by subsidies and tax revenues. Taxes were raised for waste collection, landfills and the illegal dumping of waste. Estonia laid another focus on the reduction of landfills in order to meet its own ideals and also the objectives of the European Union. The requirements of the European Union have been met successfully in the past years except for the target value for the year 2020. This led to a rise of recycling in Estonia from 5 per cent in 2001 to 20 per cent in 2010 and the trend for recycling goes upwards.

#### **2.4 Waste management system financing**

Financing the waste industry is different in each of the three countries. After joining the European Union, Poland introduced a fee for the removal of waste. The amount of the fee depends on the separation behaviour of the citizens – compared to that, the former GDR did not charge a fee for the removal of waste. GDR citizens, who separated, collected and transported waste to disposal points, received a small sum of money, whose amount depended also on the type, quality and quantity of the waste materials. This system motivated people to remove waste materials and made a waste collection fee superfluous. After the unification in 1990, the GDR's waste management system underwent changes and a waste collection fee was charged.

Estonia finances its waste management system by tax revenues or subsidies. A tax is charged for the collection of waste and the tipping. With the collected taxes, Estonia builds new landfills and waste treatment plants.

As the communes only organise the collection of waste, the actual collection of waste is in the hands of private companies, who are also paid from the waste tax. The incurring taxes depend on the type and amount of waste. Further taxes incur as a kind of fine for uncontrolled and illegally disposed waste. This penalty tax is five to five hundred times higher than the actual waste collection fee per ton of waste.

## **2.5 Barriers and success factors for waste management performance**

On the one hand, the success of the waste industry in Poland, the GDR and unified Germany is based on financial factors. Polish citizens are motivated to collect and separate waste, because the amount of the waste collection fee is related to that. In case one does not separate waste this could lead to punishments like monetary fines. On the other hand, Poland invests a lot of money into the waste industry and this leads to many possibilities of waste removal. However, the infrastructure of the waste industry, the insufficient development of the treatment plants, the waste material collection and the personnel network remain still a problem. In addition, Polish citizens tend to have little or fragmented knowledge about how to separate and deal with waste. Younger generations know the waste industry system, but many older people do not know it.

GDR citizens were more motivated to separate, collect and dispose waste, because under the economy of scarcity they received financial benefits if they handed in secondary raw materials to the collection plants. The system SERO was supposed to reach as many citizens and as many societal segments as possible and motivate the masses. The benefit system was especially popular among youths, the Pioneer Organisation (a youth organisation), school classes and other societal organisations.

By introducing the Green Dot (German: Der Grüne Punkt), German consumers had to pay a surcharge when they bought a product, whose packaging was labelled with a Green Dot. This fee is transferred from the consumer to the packaging industry and guarantees the appropriate disposal of the packaging.

The effort of the Estonian government to keep up with the European Union's requirements and their own standards is evidence of the country's overall positive development. However, the fragmented education and motivation of the Estonian population to

avoid and recycle waste is in the way. In addition, communes receive 75 per cent of waste collection fees for the operation of waste sites. As recycling increases and leads to the reduction or closing of waste sites, communes receive less and less taxes. This works contrary to a proclaimed waste hierarchy, which favours waste avoidance and recycling.

## 2.6 Sources

- [1] Bilitewski, B.; Härdtle, G-; "Abfallwirtschaft- Handbuch für Praxis und Lehre", 4. Auflage, Herausgegeben 2013, Springer Verlag Berlin

### 3. Overview of waste management in Poland

#### 3.1 Overall background

Geographically, Poland is in the center of Europe and has an area of 312.679 km<sup>2</sup> with a population of 38.005.615 (2015). The official language is Polish and the currency is the Polish Złoty PLN. [European Union 2015]

Poland is an ex-communist member of the EU. Today the political system of Poland is a parliamentary democracy (officially: Rzeczpospolita Polska – Polish Republic). Its territory is divided into sixteen “voivodships” or “provinces;” and since 1999, the administrative division has been divided into three subdivisions: voivode (governor), the sejmik (regional assembly) and the marshal. The voivodship, is the highest level of the administrative subdivision, followed by the powiat (district) which can be further divided into gminas (municipalities). [Giesek 2014]

As mentioned in segment 2.1.1, there was no legal framework in regards to the waste management in the Polish People’s Republic. As a result, they were left with no real waste management system and lacked proper data collection.

The amount of waste was causing an ecological problem. From 1975 to 1990 the amount of waste had more than doubled and approximately 90 % of the waste was coming from the industry. Most of this industrial waste was dumped on the company grounds. Illegal dumping certainly played a big role, however, there were no databases proving any quantities. [Naß 1996]

According to the polish office of statistics estimations, there are 1,8 billion Mg on 10.000 illegal dumping grounds, however, there were about 3.000 officially registered dumpsites. Most of them being in the voivodship Katowice, where the center of the industry was located. [Naß1996]

The first steps to a waste management system were done, but the municipal waste generation was still poor. Many regions weren’t linked to waste collection and less than 55 % of the households had an access to the waste collection. Poland didn’t have enough money to build the logistical and technical preconditions. With the transformation to a market economy, the habits of consumption increased and with it the amount of waste per capita. The most dramatic increase in waste was the wastage of packaging, plastic



bottles and cans. Only 8 % of the citizens had access to a recyclable material collection (waste glass and waste paper). [Naß 1996]

In order for Poland to implement the KPGO 2014's and the European Union goals it needed new collection systems. Since 2015, every citizen has been obliged to separate waste. There are different systems of collection, for example parts of Warsaw separate dry and wet wastes. In most cities glass, paper, plastic and metals are collected separately. The cleansing departments have to transport the different wastes to mechanical and biological waste treatment plants, composting plants, landfills and any other waste utilization. However, for each gmina only one cleansing department is allowed to collect waste. [Repetzki 2015]

### 3.1.1 Country profile

- Official name: Republic of Poland (Rzeczpospolita Polska)
- Government: Parliamentary democracy with a bicameral parliament
- Head of state: Andrzej Duda (President)
- Languages spoken: Polish, English, Englis

#### basic information:

- Area: 312,679 km<sup>2</sup>
- Population: 38.0 million (2015 estimate)
- Capital: Warsaw
- Major cities and population centers: Warsaw (metropolitan area, about 1.7 million), Krakow (756,000), Lodz (750,000)
- Major exhibition venues: Poznan, Kielce, Krakow
- Largest airports: Frederic Chopin Airport Warsaw Airport John Paul II Krakow-Balice, Katowice International Airport, Gdańsk Lech Wałęsa Airport.
- ports: Szczecin (Stettin), Gdynia (Gdynia), Gdańsk (Danzig)
- climate: Temperate climate transition

- Location: north-south between the Baltic Sea, Giants mountains, High Tatra and Beskidy, east-west between the Oder, Neisse and bug
- Capital: Warsaw (metropolitan area) with 1.729 million inhabitants (2014)
- Population: 38,480,000 (2014), 123 people per square kilometer, growth rate: -0.1%
- Language: Polish
- religions / churches: (2011) Catholics (33.7 m), Orthodox (156,000), Jehovah's Witnesses (137,000), Lutherans (71,000), Reformed, Methodists, Old Catholics, Jews, Muslims
- National Day on 3 May (first Polish Constitution 1791); November 11 (restoration of independence in 1918)
- Government: Parliamentary democracy (bicameral parliament) and President with (limited) executive powers
- Head of State: President Andrzej Duda
- Head of government: Prime Minister Beata Szydło, Law and Justice (PiS), Appointed 11/16/2015
- Foreign Minister Witold Waszczykowski, Law and Justice (PiS), since 11.16.2015

GDP	2015: 427.7 billion Euro (US \$ 474.3 billion)
	2016: 432.4 billion Euro (US \$ 474.2 billion) (forecast)
	2017: 455.8 billion Euro (US \$ 497.6 billion) (forecast)
Per capita GDP	2015: 11,100 Euro (12,300 US \$)
	2016: 11,200 Euro (12,300 US \$) (forecast)
	2017: 11,900 Euro (12,900 US \$) (forecast)
Economic growth in	2015: 3.6%

	2016: 3.7% (forecast)
	2017: 3.6% (forecast)
Inflation	2015: -0.7%
	2016: 0.0% (forecast)
	2017: 1.6% (forecast)
Exchange rate	1 EUR = 4.4078 PLN (April 2016)
Membership in regional organizations	EU, the Baltic Sea States
Country rating / credit (According to Institutional Investor)	March 2016: Rank 28 Solvency Index: 73.8
Main industries and sectors	industry; Trade; construction industry; Transport, logistics

Source: Germany Trade & Invest

foreign trade:

	<b>Export</b>	<b>import</b>
<b>Volume:</b>	2014: EUR 165.7 billion 2015: 178.7 billion euro	2014: Euro 168.4 billion 2015: € 175 billion
<b>key Trading partner:</b>	Germany, UK, Czech Republic, France,	Germany, Netherlands, China, Italy

**products and**

**Groups of**

<b>goods food:</b>	Automotive and Parts; Machinery; chemical products;	Chemical products, Machinery, E Electronics; Automotive and Parts
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The lowlands of Poland is dominated by ice ages, so the soils are very fertile. In the south, the mountains connects with heights up to 600 m. The mountain zone is formed by the Sudeten and Carpathian. To the south, the Upper Silesian industrial district, which is home to significant amounts of coal deposits.

In the 18th century Poland was divided by its neighbors Prussia, Austria and Russia. Finally, as a result of the first world war, the polisch state was reassembled. Today's state territory arose as a result of World War II. At the same time Poland received German territories to the east of the Oder and Neisse. However, the Eastern Provinces associated to the Soviet Union. In 1989, after the end of the socialist system of government, the market economy was established in Poland.

Since 2004 Poland has been a member state of the European Union. The average age is six years under the German average of 39 years. The Polish society is ethnically homogenous, about 98% of the residents are of polisch nationality. The largest national minorities form Belarusians, Ukrainians and Lithuanians in the east, whilst germans live in former german territories in the west. The economy and globalization leads to an increasing number of foreign workers.

At the top of the Republic of Poland rules the presdident elects every five years. The legislative forms of the Sejm (parliament) with 460 and the Senate with 100 members. The parliament elects the prime minister.

Poland is subdivided in 16 regions (similar to the federal states of Germany), counties and municipalities divided. The provinces have their own parliament. Its members are about to be elected in four year periods. Furthermore their are Voivod, who have responsibility of the public services, such as Police and fire departments. In addition, the province governor supervises the operations of public services as the representative of the central government. [Polen travel 2016]

#### 3.1.2 Development of economic and environmental situation

The economic structure of Poland is similar to that of other developed European countries. In 2015, Poland had a Gross Domestic Product (GDP) of 427.737 billion EUR [European Union 2015]. Most of the GDP is produced in the service sector. The industry sector (which includes energy) has a gross value added of 25,1 % and the agriculture sector accounts for just 4,4 %. [Switzerland Global Enterprise 2013]

Even though the financial crises caused a significant downturn, in 2009 Poland was the only European economy with a positive GDP rate. Years 2010-11 represented a period of gradual recovery for the Polish economy, thanks in part to their main export partners Germany, UK and the Czech Republic. [Switzerland Global Enterprise 2013]

Poland has the largest economy in Central Europe and its economic growth rate has been one of the best in the EU. However, to become and remain a member of the EU, the Union demands compliances, which includes among others, environmental protection. Poland has a long way to go to meet EU standards in environmental protection, but has seen positive changes since 1990.

Poland being the main beneficiary of the current 7-year period of EU funds, has been given the resources to improve their environmental protection standards. Dedicating 10 % of their funds, which amounts to approximately 10 billion EUR, to environmental protection and resource efficiency between 2014 and 2020. [Switzerland Global Enterprise 2013]

## **3.2 Waste management situation in Poland**

### ***3.2.1 Legal and institutional framework of waste management***

- **Before 1990**

Changes of environmental protection regulations originate in the 1960s and stem from activities of the United Nations Organization. At the 23<sup>rd</sup> session of the General Congress of United Nations, in December 1968, the issue of ecological effects of uncontrolled technological development, industrialization, urbanization and industrialization of agriculture was taken up for the first time as a problem of international reach. [Banse 2007]

During this period, Poland was controlled by communists and was called the Polish People's Republic. At the time, Poland didn't belong to the UN, still it began elaborating new rules of environmental protection. In 1976, an amendment was made and two paragraphs were added to the Constitution of the Polish People's Republic, inspired by the United Nations Environmental Program from 1975. [Banse 2007]

Amendments to the Constitution of the Polish People's Republic:

*“Article 12 (2) The Polish People’s Republic ensures the protection and rational management of the natural environment, which is the wealth of the whole nation.” [Simons 1980]*

*“Article 71 Citizens of the Polish People’s Republic have the right to take advantage of the benefits of the natural environment and the duty to preserve it.” [Simons 1980]*

After these amendments were added there were no more changes concerning the environment until the structural and political transition in 1989. [Banse 2007]

- After 1990

After 1989, while Poland transitioned from a centrally planned economy to a market driven one, Poland started to prepare itself for the EU waste requirements. The first waste management act came on January 1<sup>st</sup>, 1998. Another Act was published in April 2001, which introduced the waste hierarchy. The hierarchy went as follows:

- waste should first and foremost be prevented,
- reusing,
- recycling or composting,
- recover the energy by incinerating
- and as a last resort be placed on a landfill (which has the highest negative environmental impact). [Fischer 2013]

A turning point in Poland’s waste management came with the accession to the EU. Poland was obliged to bring its waste management laws inline with the EU requirements (Framework Directive, Landfill Directive, Packaging Directive). The Act passed on April 27<sup>th</sup>, 2001 outlined an obligation to develop Waste Management Plans every four years. The current National Waste Management Plan began in 2014 (KPGO 2014). [Switzerland Global Enterprise 2013]

KPGO 2014 targets for the management of municipal waste in Poland includes:

- ➔ organize the systems of municipal waste collection and the systems of separate collection of waste which is to include all households by 2015.
- ➔ reduce the storage on landfills (cf. 2.3.2.1).
- ➔ achieve a 45 % collection rate of used portable batteries and accumulators by 2016.
- ➔ recovery level of at least 60 % and a recycling level of 55 % of packaging waste by December 2014. [Poland 2010]

The points mentioned are just the main targets, however, many more objectives were outlined. The long-term goal for the EU is to prevent the waste and become an effective recycling society. In short, the EU wants to become more preventive and less reactive in terms of its waste management.

### 3.2.2 Development of waste management situation and infrastructure

- **Before 1990**

#### Amounts:

The yearly generated municipal waste per capita from 1995 to 2014 (no data available before 1995) is shown in figure 1. As the organized waste collection was still in progress in the middle of the nineties it is evident that the amount of generated waste was not stable until 2005. Only 78 % of the population was connected to an organized waste management system in 2008. The amount of waste per capita until 2005 only covers the municipal waste which was collected, whereas the data after 2005 also includes the assessment of the generated amount that was not collected. [Fischer 2013]

Between 2005 and 2012, Poland generated about 315 kg per capita each year. This trend declined over the last few years, which can be attributed to their waste prevention programs.

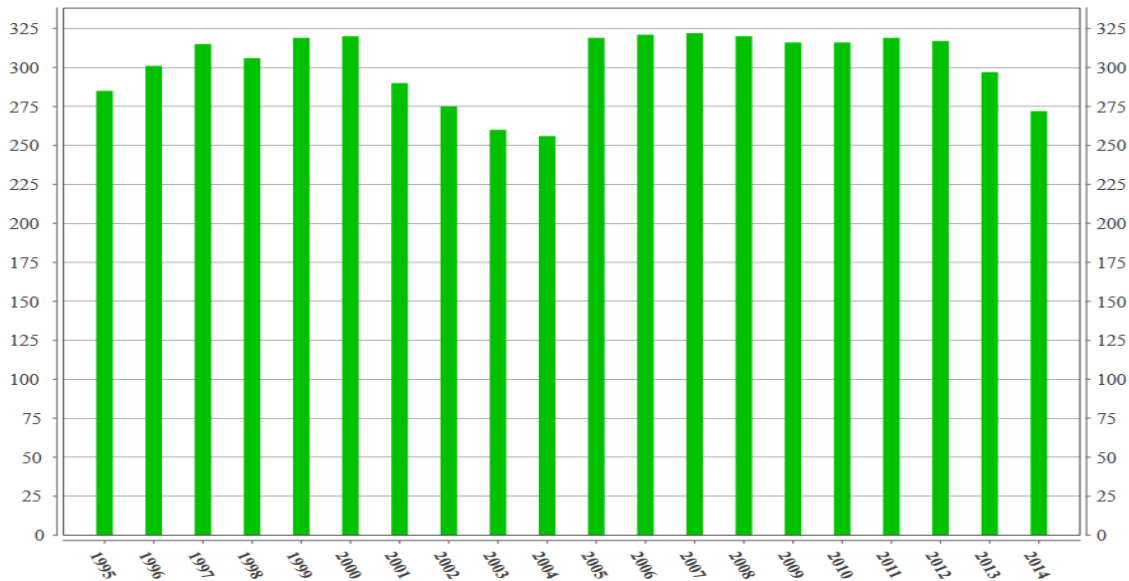


figure 1: Municipal waste generated in kg per capita

#### After 1990

##### Amounts:

Currently, Poland produces approximately 12 million Mg waste each year. Compared to other EU countries it ranks sixth, but positively, it has the lowest amount of generated waste per capita. Still, it is estimated that approximately 2 million Mg of waste still get dumped illegally. [Lohe 2014]

##### Disposal Situation:

The total waste generated and the methods used for treating the waste is shown in Figure 2. The majority of the municipal waste is still landfilled and according to the EU Landfill Directive Poland must reduce the quantity of landfilled biodegradable waste. According to the directive, compared to 1995, the amount of landfill should have dropped 25 % by 2010, 50 % by 2013, and 65 % by 2020, and unfortunately, Poland couldn't reach the goal in 2010. [Fischer 2013]

The recycling rates increased from 6 % in 2001, to 21 % in 2010, including composting as a biological recycling treatment [Eurostat 2016]. Furthermore, figure 2 exhibits that incineration increased in the last years as well.



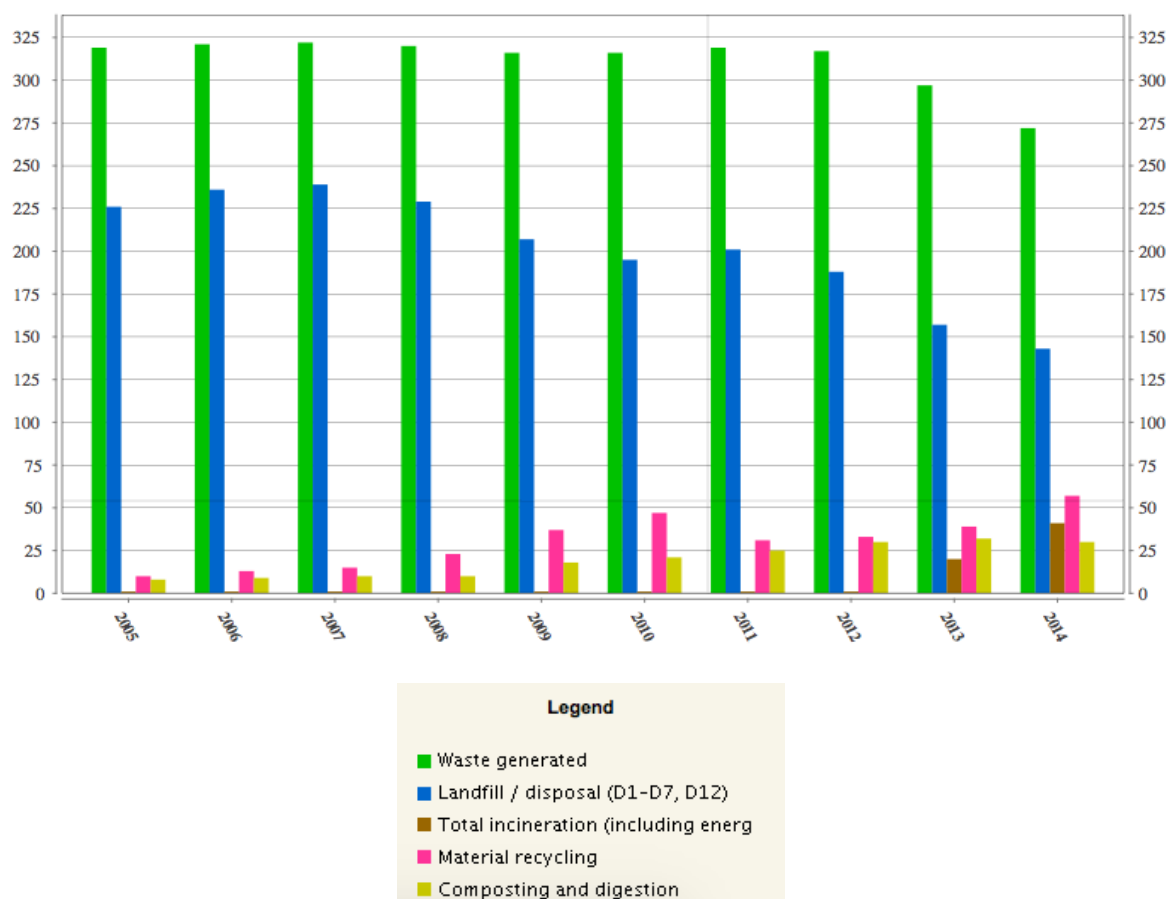


figure 2: Municipal waste treatment in kg per capita

To reach these goals in the future, Poland needs alternative methods. It is necessary to achieve the increasing recycling rates every year. At the same time, waste prevention should be a focus as well.

For nearly two decades, the incineration plant in Warsaw was the only one of its kind in Poland. By the end of 2015 a second incinerator was taken into test operation, and six more waste incineration plants are in construction phase with a total capacity of 1 million Mg. [Repetzki 2015]

In 2010, Poland had 85 installed composting plants, 4 fermentation plants and 9 mechanical and biological waste treatment plants [Poland 2010].

By 2012, the improvements to Poland's waste management systems led to the closing of 61 landfills. The other 527 legal landfills are improving step-by-step until the environmental standards of the EU are met. [Giesek 2014]

### 3.2.3 Legal and economic instruments to support waste management hierarchy

Poland has aligned its laws to European legislation, so that economic objectives are achieved on a European scale. The standards of waste management are also set to rise and are in detail:

- The target for 2014 was a recycling rate of 55% and the recirculation of 60% of packages
- By 2020, 50% of recycled paper, metals, plastics and glasses from households will be used as secondary raw materials
- By 2020 the biodegradable waste will be reduced to 65% on landfill sites
- By 2016, up to 45% of the batteries and accumulators are to be collected
- Per inhabitant, 4 kg of used electric and electronic household appliances should be collected

In 2012, a waste hierarchy was introduced in Poland and is structured as follows:

1. Prevention
2. pre-spreading for recycling
3. recycling
4. other use
5. remove.

Another novelty is the creation of a database on products and packages. This contains data on:

- lubricants, tires and the resulting waste
- imported packaging and packaging products with the related waste
- achieved recovery and recycling rates for packaging, vehicles, electrical appliances and batteries
- types, quantities and producers of the waste produced
- waste disposal sites, treatment plants and their locations, processing capacity, type of applied technologies and the quantities of waste being processed

In addition, waste management in Poland is supported by the Packaging Act and the Act on Clean-up and Order in Municipalities. The Packaging Act sets an extended responsibility for producers placing products with packaging on the market. Since the end of 2014, anyone who places packaged products on the market is in the obligation to achieve fixed recovery and recycling rates. Companies that produce less than one ton of packaging material per year are an exception.

A new waste management system should be introduced within 18 months, according to the Act on Clean-up and Order in Municipalities. The newly introduced system is intended to take full responsibility for the waste produced. Furthermore, municipalities should set and charge fees for the collection and treatment of waste. The municipalities are under the responsibility to commission independent companies with the acceptance and treatment of the municipal waste. The law presupposes the separate collection of waste, the removal of illegal landfills and the reduction of the landfilled waste.

According to the law, the municipalities are also responsible for:

- creation of sites for separate collection
- information for collection points for the acceptance of electrical and electronic equipment
- observe recovery and recycling rates
- reduction of biological waste on landfills
- information campaigns in the area of waste separation
- determination of the fees for the treatment of waste

#### 3.2.4 Waste management system financing

The waste management system in Poland was financed by waste fees. Basically, there are four methods for the calculation of fees:

- the budget (equal charges for each household, regardless of the number of persons)
- the number of persons in the household
- the living space
- water consumption in the property

The amount of the fees will be adjusted to the local conditions in any case. The citizens' behaviour regarding waste separation has huge influence on the fee. If the citizens do not separate waste, they have to pay more. The following is an example of the waste fees in the city of Warsaw:

- 4.70 Euro per person and per month in an apartment
- two persons pay 8.91 euros
- three persons pay 11.57 euros
- four or more persons pay 13.49 euros
- single-family houses are 21.44 euros, regardless of the number of people

If there is no waste separation in households, the fees increase by about 20%.

The legislation on cleanliness and order in the community, introduced in Poland, not only creates problems for the self-management units, but also raises the waste fees of citizens. The problem is that the communities had too little time to prepare for the new legislation. Frequent problems are:

- lack of inadequate infrastructure
- lack of monitoring and control of the implemented system
- delay in the implementation of the system
- emergence of an informal sector (illegal change in the type of waste)
- insufficient monitoring of waste disposal

Due to the problems of the legislation, the costs incurred are diverted to the citizens and the collection charges are increased. Furthermore, it may happen that the prescription recovery and recycling rates are not fulfilled. The new introduced system has the following advantages:

- creation of new jobs
- opportunity for the fulfilment of European Union standards

- treatment of waste and less deposits on landfills
- increased awareness of citizens and communities
- responsibility for the waste produced is taken over.

The waste management objectives of Poland are partly financed by the support of eco-funds and European Union promoters. The financial resources play a decisive role for half of the measures. The funding measures have mainly been devoted to the development and installation of treatment facilities for municipal, special and medical waste. The following projects have been financed with funds:

- 70 projects for the construction and modernization of municipal waste treatment plants
- 13 Projects for the construction and modernization of incinerators for municipal and medical waste
- 17 projects for the construction of sorting plants
- 10 projects in the field of composting

In addition to these measures, the organization for the separate collection in municipalities is supported in 280 projects. However, many investments are needed to meet the new laws and EU requirements. In the years 2014 to 2020 about 1 billion Euro will be planned for the waste management system in Poland.

#### 3.2.5 Public awareness, education and communication initiatives

There are currently no data available.

#### 3.2.6 Barriers and success factors for waste management performance

The success factor for the waste management system in Poland are the citizens, who can save money by separating waste. Since the fees are based on their separation behaviour, it motivates them to improve it. A further incentive is laid, since penalties such as fines can be avoided if the waste separation is not observed. On the other hand, many

investments in Poland are being going into waste management, resulting in many possibilities for disposal of the waste. However, infrastructure is still a problem for waste management. There is an insufficient expansion of treatment facilities, collection and the personal network. In addition, the lack of awareness about the separation and dealing with abortion among people is little or non-existent. Many young people identify with the waste management system, but not the older generations.

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## 4. Overview of waste management in GDR

### 4.1 Overall Background

The German Democratic Republic, short GDR, was a sovereign German state from 1949 to 1990 and emerged from the Soviet occupation zone after World War II. [1]

After Germany surrendered and the war ended on 8th May 1945, Germany was occupied by the Western Allies and the USSR and divided into four military zones. The western occupation zone consisted of the British, American and French sectors, which formed later the Federal Republic of Germany (FRG). The FRG was founded on 23<sup>rd</sup> May 1949, stretched over 248.687 km<sup>2</sup> and had 50, 95 million inhabitants. [4] The eastern occupation zone was controlled by the USSR and from it emerged the German Democratic Republic. It was founded on 7<sup>th</sup> October 1949. There was a continuous political tension between the two German states, but as the Berlin Wall was built in August 1961, the separation became inevitable.

Until spring 1990, the GDR was a people's democracy under the leadership of the Socialist Unity Party of Germany (German: Sozialistische Einheitspartei Deutschlands, short: SED). The SED held all positions of power in the state, in political and societal organisations and strictly monitored the mass media. The whole economy became nationalised, the churches were, however, excluded from the political agenda. In 1989 there were civil uprisings in the GDR, which originated in the reforms of *glasnost* and *perestroika* in the USSR. The revolt led to the end of the GDR-regime and on 3<sup>rd</sup> October 1990 the GDR was disbanded. [1]

#### 4.1.1 Country profile

The GDR was a socialist state, whose economic role model was the Soviet Union. Private property – i.e. shops, companies, businesses and apartments - were nationalised. All production and goods were thus controlled by the state. After the nationalisation of the economy, politics became also centralised in the GDR. The ruling party was the Socialist Unity Party of Germany (SED), which was introduced in 1946 by the Soviet Union and formed by a coercive merger of the Social Democratic Party of Germany (SPD) and the Communist Party of Germany (KPD). According to the constitution, other parties in alliance with the SED were: The Christian Democratic Union (CDU), the Liberal Democratic Party (LDPD), the Democratic Farmers' Party (DBD), and the National Democratic Party



(NDPD). From the outside, the GDR wanted to appear as if all parties had an independent agenda and party platform, but in reality, all parties were subordinate to the SED.

The SED had a strict hierarchical structure. The district, town and municipal councils counted as the lower and middle level. The important offices for economy, education, culture and security belonged to the top level of the party. They were the elites – the so-called nomenclature. This was possible, because the nomenclature could appoint which candidates were to be chosen for any position. Thus members of the lower levels had no opportunity to present or send an own candidate for an election. Every party member could vote for a leader of the SED, but the selection of candidates was strongly limited. Apart from that the party demanded unconditional loyalty from members of all levels towards the party. All decisions of the party had to be consented to. Political decisions in the GDR could not be influenced by the citizens, because there were no free elections. Upon election day, every citizen received a ballot paper that presented candidates of the SED party. If the ballot paper was not filled out, the voter agreed with the candidates; if a name was crossed out, the voter disagreed. Elections were public and not in secret – thus every voter was under the pressure of the party.

Two of the most famous politicians in the GDR were Erich Honecker and Walther Ulbricht. Ulbricht was the SED's First Secretary from 1950 to 1971 and followed the objective to establish and strengthen socialism in the GDR. Yet more and more people started leaving the GDR – as a consequence to stop emigration to West Germany, the GDR government had the Wall built in 1961 between the GDR and the FRG.

Ulbricht resigned later, because he lacked the people's support and was succeeded by Erich Honecker. Honecker stuck to socialism, which made relations to and cooperation with neighbouring countries more difficult. Despite many attempts and reforms, Honecker did not succeed in turning the GDR into a state with a stable economy. The citizens' political and personal discontent with the GDR's development led to mass protests and finally to the end of the state.

The GDR's economy was regulated by the state. Industry and trading enterprises were nationalised and agribusinesses were unified into the Agricultural Production Cooperative (German: Landwirtschaftliche Produktionsgenossenschaften, short: LPG). A five-year plan decided how many goods were needed for the citizens of the GDR, but it also decided how many raw materials enterprises received for the manufacturing, how many employees were needed, how high the wages were and how much the product finally cost. Companies and entrepreneurs were forced to stick to economy planning, although

this hindered the overall economy and could not keep up with the real needs and consumption of the population.

#### 4.1.2 Development of economic and environmental situation

In der DDR wurde Wirtschaft vom Staat geregelt. Die Industrie und Handelsunternehmen wurden verstaatlicht und die Agrarbetriebe zu Landwirtschaftlichen Produktionsgenossenschaften zusammengeschlossen. Außerdem wurde in Fünfjahresplänen entschieden wie viele Güter in DDR benötigt wurden um alle Bürger zu versorgen. Des Weiteren legte diese Planung fest wie viele Rohstoffe die Unternehmen für Produktion, wie viele Mitarbeiter, wie hoch die gezahlten Löhne und wie hoch der Endpreis des Produktes zu sein hatten. Die Unternehmen waren gezwungen sich an den Volkswirtschaftsplan zu halten, wodurch die Wirtschaft eingeschränkt wurde und der Markt nur langsam auf das Konsumverhalten der Bürger reagieren konnte.

## **4.2 Waste management situation in GDR**

### 4.2.1 Legal and institutional framework of waste management

#### Before 1990

The economy of secondary raw materials in the GDR was shaped by many laws and ordinances, which differed from one another:

- laws that regulated the reuse and recirculation of secondary raw materials
- laws that regulated the application and use of secondary raw materials
- laws that regulated the norms to control the economy of secondary raw materials

However, many laws and ordinances were never applied as the practical requirements were not provided. The first law, the Law on the Conservation and Protection of the Environment (German: *Landeskulturgesetz*), was passed in 1970. The law was the first to

demand that the environment has to be protected from the harms of hazardous waste. The general specification of the Law on the Conservation and Protection of the Environment were partly realised by the Third Executive Ordinance (German: Dritte Durchführungsverordnung, short: DVO). The ordinance required that cities and municipalities had to be kept clean and that waste had to be salvaged. The focus was in particular on the removal of municipal solid waste and the disposal was carried out mostly on landfills. [5]

The Waste Disposal Act (German: Abfallbeseitigungsgesetz, short: AbfG) was passed on 1st July 1972 and was the first federal legislation regarding waste. The basic principle of the act was the disposal of waste, which had to be disposed of so the public good was not harmed. Furthermore there were definitions of liability and order of disposal. [9] In 1975 the Waste Management Programme (German: Abfallwirtschaftsprogramm) was introduced under the name: "Avoid – Reduce – Salvage – Dispose" (German: "Vermeiden- Vermindern- Verwerten- Beseitigen"). [9]

In 1980 the ordinance passed for the comprehensive use of secondary raw materials became the base of the work of the collection plants SERO and MAB. [5] In 1982, the sewage sludge ordinance (German: Klärschlammverordnung) was passed.[9] The Sixth Executive Ordinance from 1983 regulated the salvage and harm-free disposal of unusable industrial waste. The ordinance demanded that any industrial waste had to be inspected for usability prior to disposal. In 1986 the fourth amendment of the 1972 Waste Disposal Act was passed.

### **After 1990**

The following list contains laws and ordinances from 1990 until 2005 (German names and abbreviations in brackets):

- 1<sup>st</sup> December 1990 Federal Immission Control Act (Bundesimmissionsschutzgesetz)  
17<sup>th</sup> Federal Immission Control Ordinance (BImSchV)
- 1991 Packaging Ordinance (Verpackungsverordnung; VerpackV)
- 1991 Technical Instruction on waste (Technische Anleitung Abfall, TA- Abfall)
- 1992 Amendment of sewage sludge ordinance (Klärschlammverordnung, Abf-KlärV)

- 1st June 1993 Technical Instruction on Municipal Solid Waste (TA Siedlungsabfall, TAsi)
- 1996 Closed Substance Cycle Waste Management Act (Kreislaufwirtschafts- und Abfallgesetz, Krw- /AbfG)
- 1997 Amendment of sewage sludge ordinance (AbfKlärV)
- 1997 End-of-life vehicles regulation (Altauto-Verordnung, AltautoV)
- 1998 Battery ordinance (Batterverordnung, BattV)
- 1998 Amendment of the packaging ordinance (Verpackungsverordnung, VerpackV)
- 1998 Biowaste ordinance (Bioabfallverordnung, BioAbfV)
- 1st March 2001 Waste storage ordinance (Abfallablagerungsverordnung, AbfAbIV) [9]

### **17<sup>th</sup> Federal Immission Control Ordinance (BlmSchV)**

The 17<sup>th</sup> Federal Immission Control Ordinance was passed on 1<sup>st</sup> December 1990 and held guidelines for the incineration of waste and similar flammable materials. The ordinance gave also limits for emissions from incineration plants that targeted especially the emission of dioxins, furans and heavy metals. Existing plants had an allowed time of six years to implement the latest standards or alternatively close down the plant. [8]

### **Technical Instruction on Municipal Solid Waste (TA Siedlungsabfall, TAsi)**

The “Technical Instruction on Municipal Solid Waste (TA Siedlungsabfall, TAsi)” was passed on 1<sup>st</sup> June 1993 and held guidelines for environmentally friendly, long-term safe and maintenance-free landfills. To ensure these criteria, there were requirements regarding the location, construction and operation of the landfill and also the landfill classification system (German: Deponiezuordnungskriterien).

The multi-barrier concept (German: Multibarrierenkonzept) is introduced to enable long-term safeguard. The concept contains a combination of multiple barriers like e.g. geology, base sealing, waste and surface sealing. The multi-barrier concept can only work, if the waste is pre-treated with biodegradable components in order to reach the necessary quality before being tipped. This means that domestic waste, commercial waste similar to domestic waste and sewage sludges have to be rendered inert and stabilised before their tipping. Organic components have to be mineralised, harmful substances

may only be present in their insoluble form and there are limits for the ignition loss, TOC and and eluate. [8]

### **Closed Substance Cycle Waste Management Act (Krw- /AbfG)**

The Closed Substance Cycle Waste Management Act defined an extended notion of waste. It enclosed now also waste for salvage. The “polluter-pays-principle” (German: Verbraucherprinzip) was enforced stricter so that the waste management responsibility was now shared between communes and private producers. Public waste disposal authorities were responsible for domestic waste and the disposal of commercial waste and commercial waste producers were responsible for the salvage of their own waste. [8]

### **30<sup>th</sup> Federal Immission Control Ordinance (BlmSchV)**

The 30<sup>th</sup> Federal Immission Control Ordinance set conditions for plants with a biodegradable treatment of waste. This ordinance was valid for mechanical-biological plants and incinerator plants. According to the ordinance the affected plants have to be encased and stick to emission limit values, which are necessary because of the pyrolysed flue gas cleaning. The existing treatment plants had to be refitted until 1<sup>st</sup> June 2005 or had to be closed altogether. [7]

On 1<sup>st</sup> June 2005 the Landfill Ordinance (German: Deponieverordnung) was passed and changed the conditions of tipping on landfills. The ordinance covers the construction, operation, the close-down and the post-closure care of landfills. Furthermore, the ordinance is applied when waste is stored in long-term storage facilities and is directed at landfill operators, operators of long-term storage facilities and waste owners. The ordinance defines the lined emplacement area, the phase of disposal, which also defines the treatment and the dump category. Additionally, it sets standards for the construction of new landfills, the organisation and staff during landfill operation and for the monitoring of landfills. [7]

On 1<sup>st</sup> December 2012 the waste management act and closed substance cycle act merged into the Closed Substance Cycle Waste Management Act (KrWG). It contains a five-stage waste hierarchy and its implementation. The hierarchy's stages are:

- waste avoidance
- reuse
- recycling

- utilization of waste by burning it as a source of energy
- depositing waste on landfills

The focus lies on waste avoidance, yet the best option in terms of environmental protection has to be chosen. In addition, ecological factors, the technical, economical and social implementations and consequences have to be considered. Due to the juridical change, the focus shifted for the first time from waste disposal to waste avoidance and recycling. Waste ought to be separated and collected from the very start in order to fully utilise the material potential of the resources. To meet the quality requirements for a material salvage, a separate collection of waste flows is inevitable. According to the Closed Substance Cycle Waste Management Act, from 2015 onwards used paper, waste glass, plastics and organic waste have to be collected separately. The legal establishment of product stewardship defines responsibilities along the product life cycle. This incentivises the development of products that produce as little waste as possible. Product stewardship should also ensure the environmentally friendly reutilisation and removal after use. [8]

#### 4.2.2 Development of waste management situation and infrastructure

##### **Before 1990**

Shortly after the foundation of the GDR an economy of scarcity prevailed due to the lack of available primary raw materials. Thus a systematic collection, treatment and re-use of waste and its utilisation as secondary raw material started. At the beginning of the 1980's, the recycling economy was centralised as the economy of scarcity accelerated. Primary raw materials should be substituted. The recycling of petroleum products was especially in focus as the crude oil price from the GDR's main supplier (the Soviet Union) rose and the delivery quantity sunk at the same time. To secure and collect the secondary raw materials, two combines were founded: The combine SERO was responsible for non-metallic secondary raw materials and combine MAB was responsible for metallic secondary raw materials. Both combines worked together with commercial and private collectors and all other institutions related to the collection of secondary raw materials. [5]

The waste industrial situation before 1990 is characterised by earlier experiences as the salvage of waste materials was already in focus since the end of both World Wars. The reason for this was the pursuit of self-sufficiency with raw materials and the economy of scarcity due to war. Apart from that, the German secondary raw material industry had been always dominated by international raw material prices. As the prices for raw materials were usually very low, a reasonable industrial utilisation of waste had never been up for a debate. This raw material dominance was only suspended during World War I, the rule of Nazi Germany and World War II. The dependency from raw materials became clear for the first time from 1914 to 1918 during the war years as the enduring division from the world markets lead to a deficiency in the German Empire. The continuance of the war was dependent on the situation of raw materials and surrender due to scarcity of raw materials could not be excluded. The scarcity of raw materials became reality in 1915, but was avoided by the so-called Haber Process (German: Haber-Bosch-Verfahren), which stipulated to use domestic raw materials. This resulted in a revaluation and more intense utilisation of the scrap material trade, which collected waste and raw materials such as metals, bottles, paper, kitchen waste and different types of plants. [5] War brought the experience that an effective organisation of resource availability could be decisive for the outcome of the war. Furthermore, the experience changed political thinking and resource management received more attention.

During the era of Nazi Germany the secondary raw material industry received lots of support from politics and the overall economy. The secondary raw material industry was considered to be inevitable and called also for every citizen's participation. It was considered to be a civic duty to collect waste materials and thus support the economy and the state.

The deficiency of the war years was mirrored during the rule of the GDR. The East German government took the secondary raw material industry of the Nazi era as a role model and adopted some methods to collect waste materials. [5]

#### *Numbers and composition of the waste industry:*

The number of landfills in the GDR can only be estimated. The number of landfills for municipal solid waste were:

authorised landfills: 120

controlled landfills: 1000

illegal dumps: 10.000 [6]

*The number of landfills for industrial waste divides as follows:*

2000 landfills in total  
of which 600 contain harmful substances  
of which 200 are landfills with harmful substances  
of which 6 are hazardous waste sites [6]

*Collection system and logistic aspects:*

The collection system before 1990 was very developed and looked as follows:

- disposal points and support points
- containers
- collection points

*Disposal points and support points:*

The collection plants SERO, MAB and East German manufacturers ran disposal points for secondary raw materials. In addition to that, societal organisations and part-time collectors ran also disposal support points. The difference between the two disposal points was marginal and varied only in the opening hours – the disposal support points had limited business hours.

In areas with a high population density there were no disposal points as their operation was considered inefficient. These places had introduced mobile disposal points and citizens were informed via radio or the local press about the business hours. [5]

*Containers:*

The disposal of secondary raw materials in containers was free of charge. Containers were a supporting facility to collect the resources, which were handed in only in small amounts due to their quality. The resources were: Thermoplastics, used paper, batteries, collected scrap, cullet and container glass. The number of containers depended on the type of the collected resource, with the focus being on thermoplastics and used paper. [5]



### Collection points:

These were organised collection points in order to collect resources. Collections were carried out by different organisations, for instance: Kindergartens, schools or voluntary fire brigades. The compiled resources were later handed over to the collection point and a small financial benefit given to the collectors.

The collections differed in street and school collections. Schools encouraged their students to collect secondary raw materials and to bring them to the combine SERO in order to receive a small sum of money. [5]

### **Disposal situation**

The disposal of waste was realised by composting, incineration and tipping. The majority of waste was tipped.

### Composting:

Compost production in the GDR took place not because of waste salvage but because there was a lack of organic fertiliser. There were three pilot plants, among them one windrow composting system with dried sewage sludge. Another windrow composting system was run with wet sludge and another plant operated with a tumbling composter and subsequent windrow composting. The three pilot plants were merely tested until the end of the GDR and eventually closed down. [5]

### Landfilling:

The main form of disposal before 1990 was tipping on landfills. By 1990 there were circa 120 authorised landfills for municipal solid waste, circa 1000 controlled landfills and circa 10.000 illegal dumps. A few landfills show up in enquiries about municipal, industrial and hazardous waste as those were partly tipped on landfills.

There were no pre-treatments of waste, only hazardous waste was partly disposed of by pyrolysis. On-site inspections were rare and focussed on geological and hydrological suitability of the location. In most cases, on-site inspections were held on illegal dumps which were later legalised. The TLG 37597 (German, short for: *Technische Normen, Gütevorschriften und Lieferbedingungen*, technical norms, quality regulations and conditions of delivery) from 1981 required that landfill locations must be considered adequate by an engineering-geological or even a hydrogeological expert report. Furthermore, the TLG 37597 directed since 1981 a natural base sealing of minimum two metres thickness. In case this was not possible, it was required to add an artificial sealing of cohesive

material with a thickness of 50 centimetres and the same compactness. Yet in fact only a few East German landfills had a base sealing, because there were no financial means for environmental protection and a scarcity of necessary building materials. From the mid-1970's onwards there were experiments with impermeable film sealing. Yet during the first test the film sealing was put on limestone subsoil, which caused a mechanical destruction of the film sealing. Apart from that the film sealing was also not UV-resistant and this caused additional destruction.

As the majority of landfills had no base sealing, the leachate trickled into the soil. Only in a few cases the leachate was collected, sprayed on the landfill or channelled into a receiving water course. Very few landfills had intentions towards leachate water treatment, for instance with sewage oxidation ponds. There were hardly any or only few waste controls at the entrances of landfills – thus any waste could be tipped. Even controlled landfills checked merely the transport documents of the waste and the identity of the deliverer. A lack of on-site laboratories resulted in the lack of direct waste checking. [6]

#### Incineration plants:

Incineration was not very common before 1990. There were a total of 36 incineration plants in the GDR, which were below the standards of West German incineration plants. For flue gas cleaning only flue gas filters were used. [6]

#### After 1990

After the unification of Germany the combine SERO was turned into a holding to which 15 operation districts (German: Betriebsbezirke) belonged as limited liability companies (German: Gesellschaft mit beschränkter Haftung, short: GmbH). The collapse of the planned economy resulted also in a decline of the collection, processing and sales performances. The operation conditions of the combine SERO were lost due to the introduction of market economy. There was no longer a necessity to collect resources as their availability was secured. Subsequently the collection plants ran out of financing for collected secondary raw materials as the federal government decided against subsidising them. As the power monopoly of the GDR disintegrated there was also no longer a purchase guarantee at the disposal and support points and many compilation plants had to be closed down. The prices of SERO products could not compete with the prices of the

saturated Western market and led to an assimilation of the East German plants to Western standards.

After SERO was transferred to the "Treuhand" (trusteeship) to disintegrate the remaining SERO plants, there was also the decision to sell the individual plants to private entrepreneurs. In 1991 all SERO plants were already sold. After the transformation of the former SERO plants into free-market enterprises, the development of the Dual System Germany started also in the new federal states of former East Germany. [5]

In 1993 the Technical Instruction on Municipal Waste (German: Technische Anleitung Siedlungsabfall, short: TASI) was passed and defined new guidelines for the tipping of municipal solid waste. In order to meet the new guidelines, disposal companies, plant operators and other participants were given a reasonable amount of time for adaption. Public waste management organisations implemented the directives of TASI under great expenditures. New waste treatment plants were built and cooperation with other public waste management organisations established. Tipping as it was common during the GDR was no longer sustainable and ecologically unacceptable, landfills were either closed or, where possible, adapted to the regulatory requirements. At that time there were no possibilities to stick to the landfill criteria of TASI with the available mechanical-biological treatment plants. Only pyrolysis met these criteria. In case the particular treatment facilities were not provided, the responsible authorities stretched the transition period to a maximum of twelve years, in which more untreated waste was tipped.

The 17<sup>th</sup> Federal Immission Control Ordinance (BlmSchV) was passed on 1<sup>st</sup> December 1990 and raised the standards for incineration plants. The ordinance required the worldwide highest standards of emission limit values for incineration plants. Especially the limit values for the exhaust of dioxins, furans and heavy metals were very low. Existing plants had an allowed transition period of six years to implement the latest standards or alternatively close down the plant. [8] Due to the new standards for pyrolysis in plants, organic waste parts were destroyed, other hazardous waste is rendered inert and precipitated through flue gas purification plants. Metal waste was also precipitated and the emerging slag was purified. The released energy of the incineration process was used in forms of electricity or heating. The only waste left in this process was the residues of the flue gas cleansing. These are usually stored in underground landfills.

In 1996 the Closed Substance Cycle Waste Management (Krw-/AbfG) introduced a broader notion of waste and defined now also waste suitable for salvage. The "polluter-pays-principle" (German: Verbraucherprinzip) was enforced more consequently so that

the waste management responsibility was now shared between communes and private producers. Commercial waste producers were now responsible for the salvage of their own waste. Public waste disposal authorities were responsible for domestic waste and the disposal of commercial waste.

On 1<sup>st</sup> March 2001 the Waste storage ordinance (German: Abfallablagungsverordnung, AbfAbIV) was passed and presented a development of TASI. The ordinance intensified the TASI standards with regard to the disposal of municipal solid waste and the construction and operation of landfills. A special focus was on the landfill classification system (German: Deponiezuordnungskriterien) and the transitions periods for existing plants. Based on TASI were also all administrative exceptions for the tipping of untreated waste. By 1<sup>st</sup> May 2006 the tipping of untreated or biodegradable waste was definitely not possible anymore. [8]

#### **Numbers and composition of the waste industry:**

The following table 1 exemplifies the amount of domestic and bulky waste for 2004.

	waste from households	
	per 1000t	per capita [kg]
House and bulky waste	17.045,80	207
Waste similar to household waste	14.452,40	175
total	37.583,90	456

The following table 2 shows the developing numbers of landfills from 1990 until 2000. Because of the unification of Germany, the number of landfills in former East Germany reduced significantly. In the course of this development, the remaining landfills in East Germany assimilated to the standards of the FRG.

	1990	1993	1995	1998	2000
Landfills (total)	8.273	562	472	421	333
Landfills (new federal states)	7.983	292	202	179	not known

Figure 3 shows the decline of landfills in Germany from 2000 until 2009.

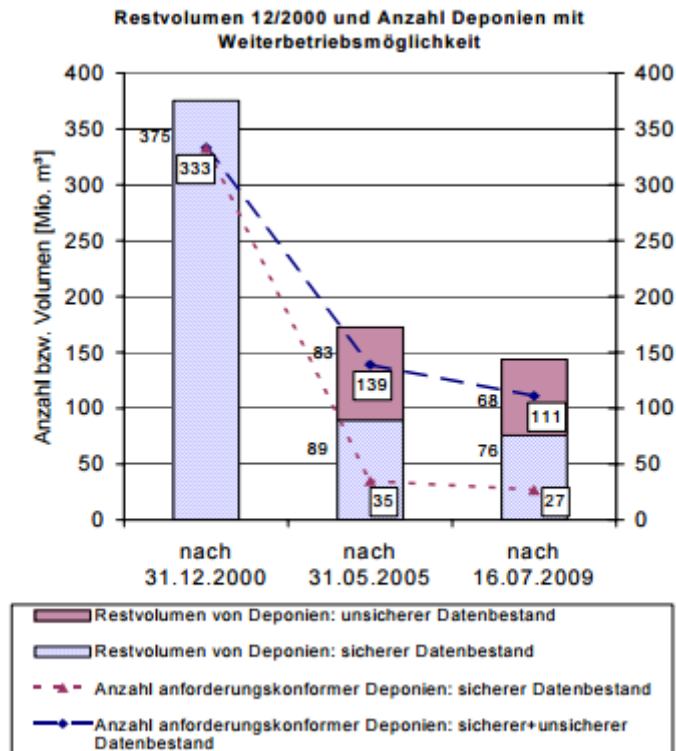


figure 3: Number of landfills with residual volume

The waste industry has changed between 1990 and 2005 – a closed substance cycle waste management has started to slowly replace disposal management. The objective is to preserve natural resources and manage waste in an environmentally friendly way. Another big role plays resource efficiency.

Building and demolition waste produce the largest amount of waste in Germany – annually circa 325 to 350 million tons. These waste types make up 60 per cent of the overall annual waste production; 14 per cent are municipal solid waste and hazardous waste amounts to five per cent.

There are a couple of high-quality disposal procedures available to regulate these waste flows. Depending on the type of waste, several different waste treatment procedures can be applied. [8]

### **Numbers and composition of the waste industry:**

The following Table 1 shows general information about municipal solid waste in 2013:

Table 1: general information about municipal solid waste in 2013

waste type	amount of waste	Remaining in waste disposal facilities					recovery rate
		disposal method			recycling methods		
		Landfilling	thermal methods	elimination methods	energetic recycling	material recycling	
		[1000 t]					[%]
amounts of waste	385.729	67.434	10.015	4.353	38.375	265.552	79
thereof							
house waste	29.250	28.898	0	16	6	330	87

Table 2 shows the waste accumulation of domestic waste for 2014.

Table 2: waste accumulation of domestic waste from 2014

	waste from households	
	per 1000t	per capita [kg]
House and bulky waste	15.518,10	191
Waste similar to household waste	13.170,60	162
total	37.6	462

### **Collection system**

Waste in Germany is compiled by a collect and bring system. In the collect system, waste is picked up directly at the waste producer. Usually, residents put their refuse containers

directly at the kerbside to be emptied by the refuse collection. As the various waste categories have to be collected separately, the refuse bins will be emptied only on different days in scheduled intervals.

This system is beneficial for the citizens, as it causes little effort to them. However, the costs and logistic efforts are considered a disadvantage.

Compared to that, in the bring system the waste producer brings waste and resources to a decentralised collection point. From there the collected waste is transported further. The advantage of the system is the relatively low costs and logistic effort. But the deciding disadvantage is the dependency on the citizens' support, who must actively support the system by their delivery. The bring system is put into effect with containers and buyback centres.

Along some typical application areas, further distinctions of collection procedures are made:

- revolving discharge system
- rotation process
- single-cycle collection
- systemless removal

The revolving discharge system is a procedure where provided container systems with corresponding waste are emptied during a removal. The removal of waste takes places in regular intervals and there is a difference between partial and full service. Partial service implies that citizens put their waste containers on the kerbside for removal, full service doesn't require this. A typical area of application for the revolving discharge system lies in the domestic and partially in the commercial sector.

The rotation process is when a full container is exchanged for an empty container. This process is applied merely with large amounts of waste such as industry and building waste.

Single-cycle collection is applied with waste bags made of plastic or paper and filled with green waste, residual waste and waste from the Dual System Germany (DSD waste).

The removal of big and bulky waste which cannot be transported in containers is on call. The logistics of removal is realised by collection vehicles which collect waste and transport it to a disposal facility. [13]

## **Disposal Situation**

The German disposal situation is very good. Waste is disposed of with biological procedures, thermic procedures and in small quantities tipped.

### **Landfilling:**

Landfills are categorized in five different construction classes. Landfill classes are structured as follows:

- landfill class 0: landfills for inert matter
- landfill class I: landfills with small amount of organic matter, releasing pollutants
- landfill class II: landfills with municipal solid waste
- landfill class III: overground landfills for hazardous waste
- landfill class IV: underground depot

The standards are highest in landfill class 0 and gradually decline until landfill class IV. For tipping, the multi-barrier concept is applied. The objective of this concept is a permanent prevention of harmful emissions and a limitation on environmental damage. The concept is a combination of several barriers. The barriers must be independent of each other so that in case one barrier is damaged the overall protection is still guaranteed. The multi-barrier concept consists of the following six barriers:

1. waste treatment
2. geology and hydrology
3. inner and outer stability
4. base sealing
5. surface sealing
6. landfill operation

Waste pre-treatment serves the minimisation of emissions and is realised through separate collection, pre-sorting, mechanical-biological treatment, thermic treatment, mechanical-physical treatment and reception inspection. The barrier of geology and hydrology serves the long-term, natural shielding of ground water from the landfill body and the leachate. The inner and outer stability of the landfill body has to be observed and



ought to be predictable as waste brought to the landfill has different solidity and stability. Furthermore, the degree of consolidation of the used waste plays a crucial role for stability.

The base sealing is thus a kind of safeguarding in case the hydrological barrier is destroyed. This can also prevent the leakage of leachate. Upon installation of a base sealing it is important to consider that no ground water can soak into the landfill body. There are many natural, synthetically-mineral and synthetical-polymeric materials in use for base sealings. Depending on the type of landfill, a two- or three-layer base sealing is required.

To create a barrier between the environment and the landfill body, a surface sealing is required. It provides protection against the weather, makes the landfills gas-proof and allows for controlled gas collection.

The last barrier of the multi-barrier concept is maintenance. This means to repair damaged parts and permanent monitoring of individual parameters. [12]

#### Biological waste treatment:

Biological waste is waste of animal or plant origin which disintegrates with the help of microorganisms, soilborn creatures and enzymes. The main objectives of a biological waste treatment are:

- reduction in mass and volume,
- generation of products (biogas, compost and fuel surrogates),
- following regulations on the proper tipping conditions of waste (abiding the Landfill Ordinance),
- reduction of biological activity

As biological treatment are considered: composting, mechanical-biological treatment (MBT), mechanical-biological stabilisation (MBS), mechanical-physical treatment (MPT) and fermentation. The primary objective of composting is the production of sellable compost; whereas the primary objective of fermentation is biogas production and compost production.

Biological procedures differ into two types: anaerobic and aerobic procedures. Composting of organic materials and the rotting of residual waste are considered as aerobic. The digestion of sewage sludges and fermentation count as anaerobic procedures. [10]

The mechanical-biological waste treatment is the politically demanded alternative to waste incineration plants. This type of waste treatment serves especially:

- reduction of the mass by 30 to 40 per cent
- minimisation of leachate and aerosols (on landfills) by 90 per cent
- reduction of the methane pollution by 90 per cent

This waste treatment differs in: mechanical treatment (MT) and mechanical-biological treatment (MBT), mechanical-biological stabilisation (MBS) and the mechanical-physical stabilisation (MPS).

During an MT occurs a sewerage outflow which forms a fuel, a metal fraction and residual material for thermic treatment.

During an MBT and an MBS occurs, firstly, a mechanical and, secondly, a biological treatment of waste. During the mechanical treatment the sewerage outflow is separated and impurities are extracted prior to the biological treatment. Depending on the treatment type, waste is stabilised during the biological step of the procedure. The biological step itself can be aerobic or anaerobic. During the aerobic process, oxygen is added to the rotting. The rotting material can be burnt during a thermic treatment, the slag and ash residue are tipped. The anaerobic procedure occurs under a lack of oxygen which leads to fermentation. The rotting is eventually tipped.

During an MPS there is first a mechanical treatment of waste, which is followed by a physical drying (stabilisation). This stabilisation occurs under the impact of externally added energy. [11]

### Incineration and pyrolysis

The objectives of thermic waste treatment are:

- volume reduction
- disintegration of organic pollutants
- immobilisation of anorganic pollutants
- recycling of secondary raw materials
- energy production

Thermic treatment is structured into the following steps: incineration, the thermic conversion of residual waste under aeration, pyrolysis, gasification and the thermic conversion under addition of a fumigator.

Incineration is distinguished into three technologies: grate firing, rotary kiln and fluidised bed combustion. [14]

### 4.2.3 Legal and economic instruments to support waste management hierarchy

Market economy was introduced after the unification of Germany. As a result, the former GDR citizens lost the ambition to collect and hand in secondary raw materials as resources were now continuously available. There were no longer any financial means for the acquisition or compensation for collected resources as these means were originally provided by the GDR's government, but the German government ceased the subsidies. In 1990, the "Dual System Germany" (German: Duales System Deutschland) was founded – shortly before the introduction of the Packaging Ordinance (German: "Verpackungsverordnung"). It is a company for waste avoidance and the retrieval of secondary raw materials. The company was founded because of the imminent waste disposal crisis in the beginning of the 1990's. The objective of the Packaging Ordinance is until today to preserve the environment and reduce packaging waste. Apart from that it supports also the re-use of packaging waste. According to the principle of the Dual System, both manufacturer and distributor pay a financial compensation to be exempted from the take-back obligation. As identification for the Dual System the "Green Dot" (German: Der Grüne Punkt) was introduced. On the one hand this badge serves the customers as identification of the Dual System, on the other hand it indicates which companies participate in the take-back system.

### 4.2.4 Waste management system financing

The economic system of the GDR was tied closely to the combine SERO. The combine was an essential element of the economy and was supposed to increase the GDR's economical efficiency. Citizens were encouraged with a small financial compensation to separate and collect secondary raw materials. This compensation was, however, subsidised – thus secondary raw materials were not only cheaper than primary raw materials, but also more frequently used in the East German industry.

As GDR politics prioritised the use and salvage of secondary raw materials, there was no cost calculation for economic processes. There are hardly any facts available from GDR business administration. A detailed breakdown of the costs is not possible as there was only a unit cost calculation. As the SERO combine expanded, not only further processing plants but also cost unit accounting became necessary. Yet many economic reports from the GDR have mistakes and deficits in their accounting.

The unit cost system was accounted per thousand quantity units, i.e. the costs for collection, processing and sales of one quantity unit was used. Yet individual production steps could not be related to precise costs. The indirect costs were made up as follows:

Trading costs (projectable) + unnecessary expenditures for society

- costs for industrial production
- cultural costs
- commercial risk costs
- commission expenses
- labour and processing expenses
- unnecessary expenditures for society

There is no possible addition of the cost for the single branches, as the costs were calculated for different product groups based on an individual scheme. Apart from that it was not clear, which costs are already calculated into the purchase price and which are part of the sales deduction. Due to the direct cost calculation, it was not possible to account for the actual costs for the treatment procedures, which probably caused higher costs than initially assumed.

The overall economical inaccuracy led to false declaration about the acquisition of secondary raw materials.

#### 4.2.5 Public awareness, education and communication initiatives

Citizens of the GDR were raised from childhood on to avoid and recycle waste. Waste was collected in kindergartens, schools and other social institutions and the financial compensation for the secondary raw materials was put into institutional or class funds. Private households also collected secondary raw materials in order to improve their financial situation. To avoid waste was an everyday issue as people owned few resources or could not easily buy them. Thus people used products and goods as long as possible.

#### 4.2.6 Barriers and success factors for waste management performance

GDR citizens were more motivated to separate, collect and dispose waste, because under the economy of scarcity they received financial benefits if they handed in secondary raw materials to the collection plants. The system SERO was supposed to reach as many citizens and as many societal segments as possible and motivate the masses. The benefit system was especially popular among youths, the Pioneer Organisation, school classes and other societal organisations.

By introducing the Green Dot (German: Der Grüne Punkt), German consumers had to pay a surcharge when they bought a product, whose packaging was labelled with a Green Dot. This fee is transferred from the consumer to the packaging industry and guarantees the appropriate disposal of the packaging.

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## 5. Overview of waste management in Estonia

### 5.1 Overall Background

The quantity of waste in Estonia rose strongly during the 1990's. However, the amount of hazardous waste has shrunk. The majority of hazardous waste is produced by the oil shale production.

In 1995 only 13 per cent of municipal waste was treated. Any other waste was not treated and simply tipped on one of the 450 landfills. Many of those landfills were already in 1995 not built according to ruling standards. Often the landfill bodies leaked, hazardous materials were washed out by precipitation and seeped into the soil and ground water. Furthermore, there is too little information on contaminated industrial sites or the disposal of hazardous waste.

Between 1993 and 1995 the recycling rate rose from 11 per cent to 21 per cent and currently Estonia aims at a further increase of the rate. Since 1995 Estonia develops a national waste salvage program that invests in new recycling plants, treatment and disposal of hazardous waste. Yet for the control and restoration of existing landfill the municipalities lack financial and technical means. One of the objectives was to reduce the number of landfills to 120 by the year 2000. The violation of ruling standards increased continuously from 1992 (143 violations) until 1995 (647 violations).

#### 5.1.1 Country profile

##### **General information:**

- Official name: Republic of Estonia (Eesti Vabariik)
- State: Republic, Parliamentary Democracy
  - Head of state: President of the Republic of Toomas Hendrik Ilves, elected on 9 October 2006, reelected by Parliament on 29.08.2011 for a second five-year term.
  - Business languages: Estonian, English, Russian, Finnish, German

##### **Basic data:**

- Area: 45,227 km<sup>2</sup>

- Population: 1.3 million (2016, estimate)
- Capital: Tallinn
- Largest cities and conurbations: Tallinn (430,594), Tartu (Dorpat) (102,000), Narva (66,000)
- Main exhibition areas: Tallinn
- Largest airports: Tallinn, Tartu, Kuressaare
- Ports: Muuga, Tallinn, Kunda
- Country names: Eesti Vabariik (Republic of Estonia)
- Climate: maritime to moderate continental, very long winters, cool summers
- Location: Tallinn (formerly Reval) is situated on the sea level at the latitude of Stockholm, about 80 km south of Helsinki
- Surface area: 45,227 sqkm
- Capital: Tallinn 430,594 inhabitants, of which 38.6% are ethnic Russians
- Population: Total population: 1,315,819, including ethnic Estonians: 69.8%; Other ethnic groups: Russians 25.2%, Ukrainians 1.7%, whites 0.9%, Finns 0.6%, others 1.8%
- Language: Estonian (only official language), Russian (traffic language in regions where the Russian-speaking population is domiciled, especially in the north-east)
- Religions / Churches: Protestant-Lutheran and Orthodox, with non-Estonian population dominated Russian-Orthodox
- Independence: Declaration of Independence 24.02.1918, after Soviet occupation Declaration on the restoration of independence on 20.08.1991 (public holiday since 1998)
- State / Government: Republic, Parliamentary Democracy



- Head of State: President of the Republic of Toomas Hendrik Ilves, elected on 9 October 2006, reelected by Parliament on 29.08.2011 for a second five-year term.
- Gross domestic product (GDP): EUR 20.5 billion (2015); EUR 20 billion (2014)
- GDP per capita: EUR 15,598 (2015); 15,186 EUR (2014)
- Growth rate GDP: 1.1% (2015)
- Inflation rate: -0.5% (2015)

### 5.1.2 Development of economic and environmental situation

#### Economy:

Table 3: Data of Economy

GDP	2015	20,5 Mrd. Euro
	2016	21,2 Mrd. Euro (prognosis)
	2017	21,2 Mrd. Euro (prognosis)
GDP per capita	2015	15.600 Euro
	2016	16.200 Euro (prognosis)
	2017	17.100 Euro (prognosis)
economic growth	2015	1,10%
	2016	1,9 % (prognosis)
	2017	2,5 % (prognosis)
inflation rate	2015	0,10%
	2016	0,8 % (prognosis)
	2017	2,9 % (prgnosis)

#### Foreign trade:

Table 4: Date of foreign trade

		export	import
Volume	2014	12,1 Mrd. Euro	13,8 Mrd. Euro
	2015	11,6 Mrd. Euro	13,1 Mrd. Euro
important trading partners		Sweden, Finland, Latvia, Russia, Germany, Lithuania	Finland, Latvia, Lithuania, Germany, Sveden

products and products groups	electronics, resources, food, machinery	electronics, food, chemicals, oil
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### State structure:

With the constitution of the 28th June 1992 Estonia is a parliamentary democracy. The constitution holds fundamental rights and the division of powers. The head of state is the president, who is elected by the parliament. Below the parliament is the prime minister, who administrates the government.

Estonia has a two-tier administrative structure. The first tier is the central government, which elects the second tier - the district chief executives from 15 administrative districts. The parliament is elected by the Estonian people and non-Estonians, who have the right of unlimited residence. Currently there are six parties in the Estonia parliament. The government coalition consists of Reform Party, Social Democratic Party and the conservative IRL party. Currently the 16<sup>th</sup> government exercises the authority.

### Outline of foreign policy:

Estonia keeps a strong relationship to international organisations like e.g. the European Union, NATO, OECD, WTO and the European Council. Apart from that it maintains a close relationship to the United States and strengthens regional cooperation in the Baltic Sea region – with a special focus on the Scandinavian neighbour countries. Furthermore, Estonia supports the integration in Western structures for its eastern and southern partners within the European Union.

### EU policy:

Since 1st May 2004 Estonia is a member of the European Union. In January 2011 Estonia joined the European Zone. As a member of the EU the country pursues an economy and policy of stability. In 2012 the Estonian parliament agreed with a majority to the European Stability Mechanism Treaty. Six Estonian representatives have a seat in the European Parliament. Andrus Ansip is since 1<sup>st</sup> November 2014 the Vice President of the European Commission and also in charge for the EU's digital agenda.

Estonia's European policy focuses on the extension of the European single market and the digital market. Another objective is the Estonian integration into European infrastructure systems.

Along with Germany, Estonia pursues within the EU framework a sustainable budgetary policy and the development of competitiveness through structural reforms.

*Economic situation and structure:*

Estonia has a liberal economic policy. After an economic crisis in 2008 and 2009 the country recovered with a growing economy until 2012. Yet due to strongly decreasing demand from Finland, Sweden and Russia, the growth declined again in 2013. In the following years there was only a small rise of economic growth. The EU sanctions against Russia also affect Estonia, especially the Estonian fishing industry.

Estonia has a liberal labour legislation after the Law on Employment Contracts was modified in 2009. The changes account for a stronger flexibility of the labour market and an improvement in

social security system standards of employees. After the unemployment rate rose in 2010 to its highest position of 19 per cent, it dropped continuously and is currently at 6,4 per cent. Due to low wages, younger and more qualified workers live and work abroad.

*Important economic branches:*

Economic branches of great importance are logistics, financial services, telecommunication, tourism, trade and the real estate business. Agriculture, forestry and fishing play a minor role in the economy.

The competition in logistics increases as the Baltic states and especially Russia drive the extension of infrastructure and harbours. Estonia reacts on the growing competition with large investments for the harbour development.

Communication and information technology enjoy a high status in Estonia. The country is proud of its innovative projects like the nationwide application of an e-government and e-learning. In 2015 the first-time e-voting was exercised during municipal elections. Estonia's tourism sector was one of the strongest growing branches of the country until the global economic and financial crisis. The recovery of the global economy, the establishment of new flight routes and the relatively low accommodation costs have helped to revitalise foreign tourism.

*Foreign trade:*

The liberal economic policy and the juridical adjustment to EU guidelines create attractive investment conditions for foreign companies. Investors and entrepreneurs are treated equally with regard to administrative procedures and taxes. The foreign trade volume amounts to 25,9 billion euro in 2014 and to 24,7, billion euro in 2015. The share in exports amounted to 11,6 billion euro in 2015, the share in imports amounted to 13,1 billion euro in 2015. The most important Estonian trade partners are the EU member states and Russia. Estonia exports into the member states of the European Union mostly

machinery, tools, wood and wood products, metal and metal goods, textiles and oil. Estonia participates in trade shows, but these activities are limited to Tallinn and Tartu. The trade shows are often focused on private consumption; the construction fair, the mechanical engineering fair and the tourism fair enjoy the biggest feedback.

*Environmental policy:*

According to an EU-specification, Estonia must raise their portion of renewable energies by 25 per cent until 2020. This objective was already fulfilled in 2012. Oil shale combustion poses, however, a risk to environmental policy, as 60 per cent of burnt oil shale remains as ashes. These are stored on landfills. In addition, oil shale mining causes destruction of the countryside and groundwater pollution. In 2013 the EU invested 170 million euro in the environmental sector of which 129 million euro went to the water industry. [1]

## **5.2 Waste management situation in Estonia**

### *5.2.1 Legal and institutional framework of waste management*

In 1992, Estonia passed its Waste Act. The Act defined objectives and principles of the Estonian waste management. On the whole the waste policy of Estonia matches with EU legislation – partially the policy is even stricter than the community rules of the EU. Substantial changes need to be made regarding hazardous waste as it constitutes the majority of Estonian waste. Still in 1997 there were too few binding laws for landfills and incineration plants.

### *5.2.2 Development of waste management situation and infrastructure*

When Estonia joined the European Union in 2004, the foundation for a new waste management system was laid. In preparation to the European Union the first Estonian Waste Act (2000 – 2007) focused on the implementation of the European waste legislation. According to the Waste Act the municipalities are responsible for the organisation of the collection, the transport and the disposal of municipal solid waste. Until 2007 a three-

tiered system of the waste management plan (national, nationwide and municipal) existed. The laws were changed to a two-tiered system (national and local). This forced the municipalities to take over more responsibility, to concentrate resources and increase staff and financial capacities for the improvement of the waste industry.

The second Estonian Waste Act spanned from 2008 until 2013. It implied the separate collection of biodegradable and mixed waste. Furthermore it implied the improvement for composting of biodegradable waste in rural areas. The Waste Act pursues the reduction of biodegradable waste on landfills. [2]

#### MSW- indicators:

The ensuing figure 3 depicts the development of the waste accumulation per head from 2001 until 2010. In 2001 the average per-head waste accumulation was 373 kg. In the following years this sum was not stable and rose up to 449 kg per head. Yet between 2005 and 2010 a decrease set in. Especially in 2007 and 2008 the decreased waste accumulation became palpable. It can only be speculated whether this is related to the onset of the economic crisis.

Most of the Estonian waste is tipped, but in the past ten years a decrease set in. Whereas in 2001 there were 403.000 tons tipped and in 2006 there were 373.000 tons tipped, it were only 267.000 tons in 2010. Proportionally this shows a reduction from 79 per cent in 2001 to 64 per cent in 2010.

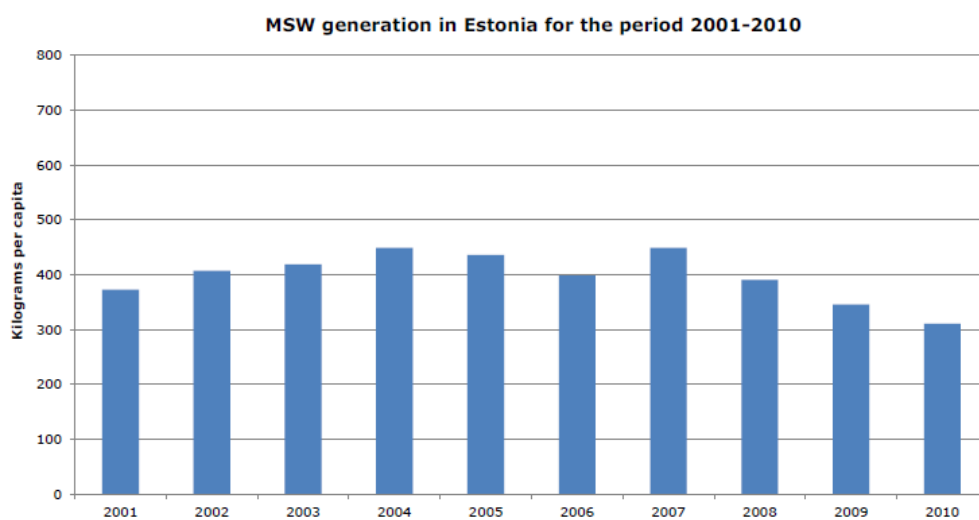


figure 4: MSW generation per capita in Estonia [2]

At that time there existed no waste incineration and no ensuing energy gain from the incineration. The incineration plants were under construction and ought to be finished by 2013 (as of 2011). [2]

The following figure 4 depicts the development of recycling in Estonia. Starting off with a 5 per cent recycling rate in 2001, this number rose up to 20 per cent in 2010. Material and organic recycling (composting and fermentation) are included within the overall recycling level.

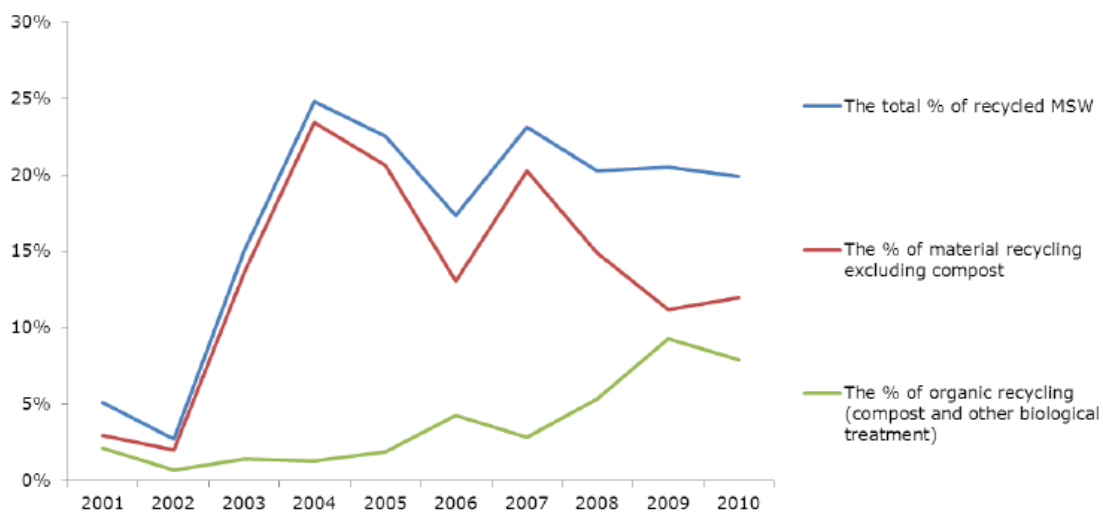


figure 5: Recycling of MSW in Estonia [2]

Recycling shows clearly positive tendencies with some fluctuation. The highest recycling rate was 25 per cent in 2004, yet the enormous rise from 2002 until 2004 is due to a methodological error. During that time a sorting plant for mixed waste started operating. Yet the recycled and salvaged resources were counted twice although it contained the same material. Thus the recycling rate rose very quickly.

#### Tipping of biodegradable municipal solid waste

As Estonia acceded to the European Union, the waste legislations of the institution had to be realised. The EU landfill directive specified for the member states the reduction of biodegradable municipal solid waste on landfills. The stipulated objectives relate to the accruing biodegradable waste from 1995 (317.000 tons). National legislation required already a detour and a ban on tipping of untreated municipal solid waste on landfills. As

of 2008 there were few plants for the pre-treatment of municipal solid waste. The second Estonian waste management plan defined a strategy for the reduction of biodegradable waste on landfills. According to the legislation, the following limits apply:

- reduction of tipped waste to 45 per cent until 2010 (related to the waste accumulation of 1995)
- reduction of tipped waste to 30 per cent until 2013 (related to the waste accumulation of 1995)
- reduction of tipped waste to 20 per cent until 2020 (related to the waste accumulation of 1995)

These limits differ from specifications of the European Union. The Estonian guidelines are stricter as they relate to the actually produced biodegradable waste – and not like the EU landfill directive to the tipped amount. For the years 2006, 2007, 2008 and 2009 Estonia presented the EU Commission with the tipped amounts. In 2009 the landfill total amounted to 155.000 tons, which is equivalent to 49 per cent of the 1995 waste accumulation. Thus Estonia reached its 2010 objective already in 2009.

The ensuing figure 5 depicts the actual amount of tipping of biodegradable waste in relation to the biodegradable waste of 1995. Furthermore, the European requirements for 2010, 2013 and 2020 have been added. The figure shows constant reduction of biodegradable waste on landfills in relation to the accrued amounts from 1995:

- 2006 →68 per cent
- 2009 →49 per cent
- 2010 →52 per cent

The reduced amounts are not directly linked to an increased recycling rate. Rather, the reduction of biodegradable waste is realised with an increase of pre-treatment in mechanical-biological plants. The first plant was built in 2007. As of 2012 the country owns four more mechanical-biological plants with an overall capacity of 300.000 tons. A composting treatment of organic waste is currently still not possible due to a lack of capacity and incineration with energy gain is still under construction (as of 2012). [2]

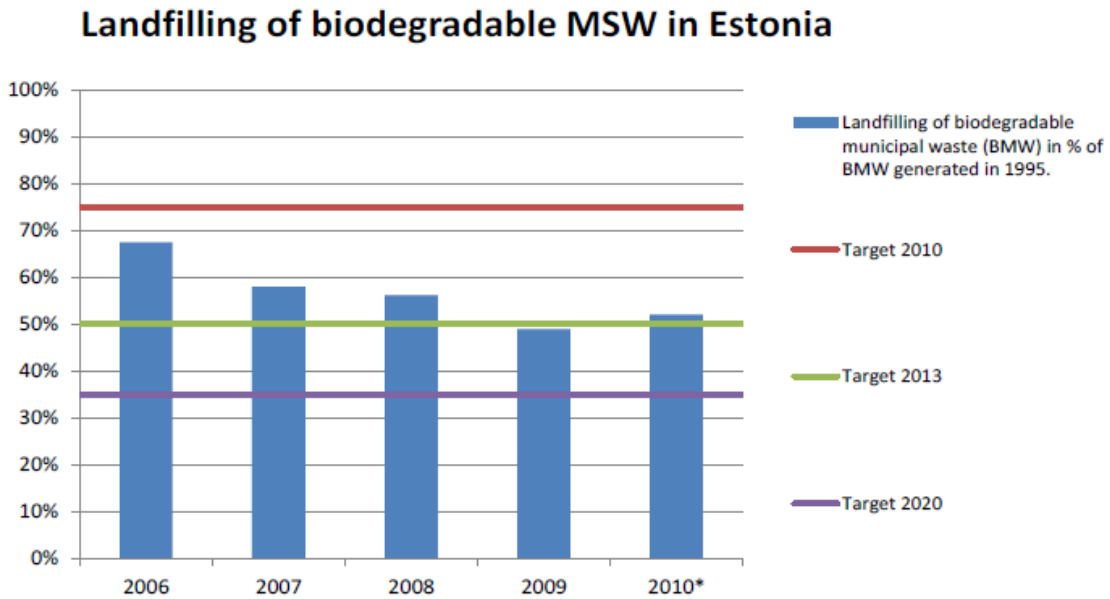


figure 6: Landfilling of biodegradable MSW in Estonia [2]

Another factor of the decrease is that the biodegradable waste accumulation of 1995 contained garden and green waste, which were also tipped. Today a waste collection tax and landfill fees amount to 50 euro per ton, which prevent the tipping of garden waste. Instead many citizens use domestic composts for green and garden waste, but the production and recycling of this organic waste is not documented.

The figure depicts that Estonia met already in 2006 the European requirement for 2010 to reduce the tipping of biodegradable waste by 75 per cent. The requirement for 2013 – to reduce down to 50 per cent – was already met in 2009. The Estonian objective of a reduction down to 35 per cent until 2020 will be difficult, yet possible with the operation of the incineration plant (as of 2012). [2]

#### Relation of landfill tax and recycling

In 1990 the landfill tax was introduced in Estonia. The tax rate is dependent on the type of waste. Any kind of disposal falls under the landfill tax. Depending on the severity of the environmental impact the tax rate can be raised individually. The tax is also raised when larger amounts than allowed are tipped. Every unduly tipped ton of waste is charged for five to five hundred times of the standard fee. This type of monetary fine stems from the USSR times when illegal dumping was a normality.



The landfill tax rose continuously in the past years:

- 1996 from 0,10- 0,20 €/ per ton of waste
- 2006 raised to 7,80 €/ per ton of waste
- 2010 raised to 10 €/ per ton of waste
- further increases up to 30 €/per ton of waste until 2015

The following figure 6 depicts a decrease of tipped waste until 2005. Since then the total amount of landfill waste has remained the same – despite the landfill tax. The rate for deposal on landfills has decreased because of the continuously rising tax liabilities and the ban on tipping biodegradable waste. Until 2010 there was still no incineration operating (as of 2012). [2]

The largest portion of the collected tax is used for the construction of new and modern landfills. Municipalities receive circa 75 per cent of the tax revenue as reimbursement for communal households. Due to the pre-treatment of organic waste in mechanical-biological plants, incineration and tipping are less common. According to that, tipping is used three to four times less, which results in a reduced tipping and reduced tax revenue. This is also why the municipalities are against the new system and the introduction of a new waste hierarchy and thus support further tipping.

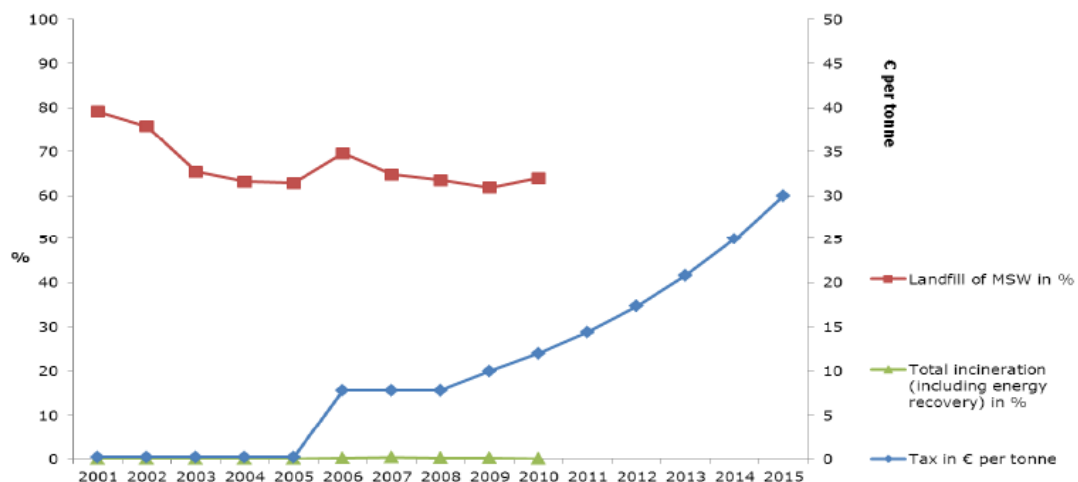


figure 7: Development of landfilling and incineration of MSW and landfill in Estonia [2]

Figure 7 depicts the total, the organic and material recycling of waste from 2001 until 2010. Additionally it shows the tax for waste disposal in euro per ton of waste for the period from 2001 until 2015. The figure makes clear that a tax increase does not automatically lead to an increased recycle rate. There was no incentive for citizens to recycle waste. [2]

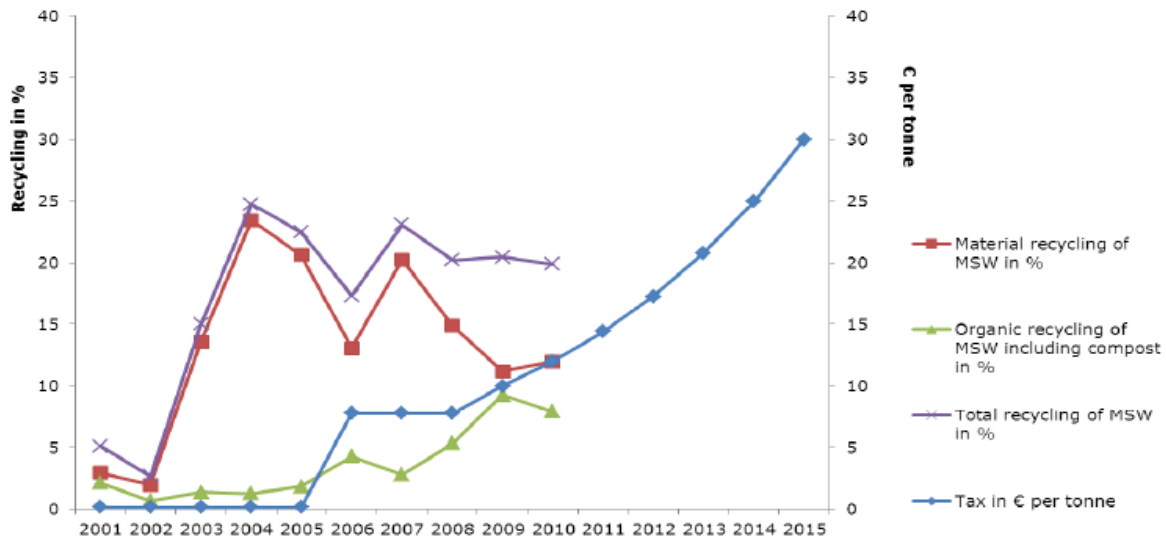


figure 8: Development of MSW and landfill tax in Estonia [2]

### Environmental benefits of a better waste management

Figure 8 depicts the development of greenhouse gas emissions from the Estonian waste management. It distinguishes in direct emissions, averted emissions and net emissions of waste management. Until the year 2000 there is a constant rise in emissions from tipping. But since tipping of biodegradable waste was banned there is a decline of landfill emissions. Yet the organic waste tipped five to ten years ago still emits emissions. As recycling is generally on the rise, the emissions due to recycling grow proportionally. At the same time the net contribution to the emissions sinks. On the one hand recycling averts the application of new resources; on the other hand it prevents the outgassing of organic waste on landfills, which reduces further greenhouse gas emissions. From figure 8 derives a positive tendency from 2003 to 2010. The net greenhouse gas emission shows a decline in greenhouse gas emissions since 2000, which stems from an improved waste management. In 2000 the greenhouse gas emissions amounted still in 550.000 tons CO<sub>2</sub> equivalents and were reduced to 400.000 tons until 2010. [2]

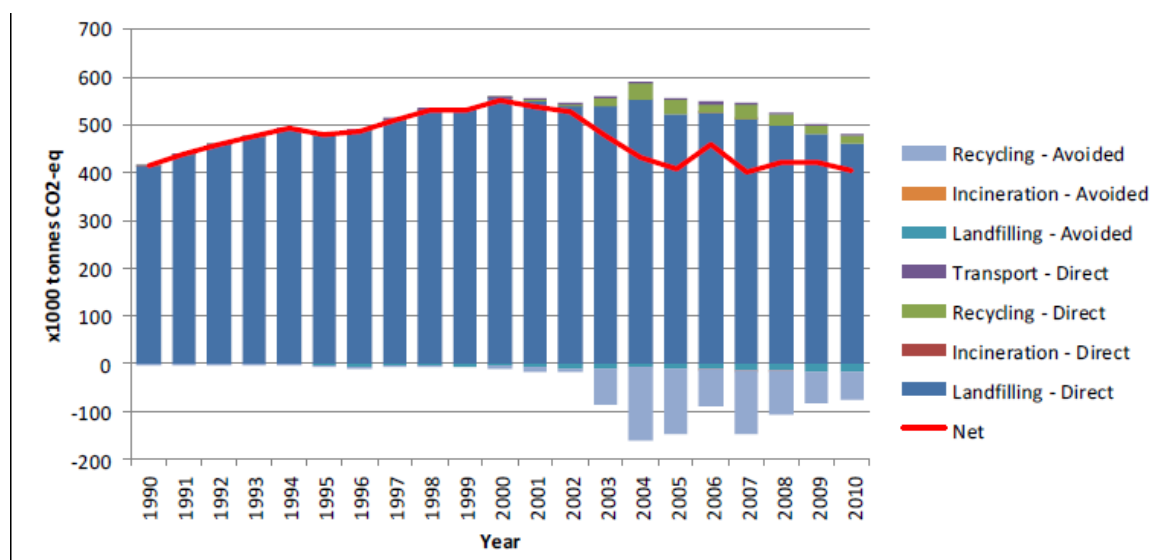


figure 9: GHG emissions from MSW management in Estonia [2]

### 5.2.3 Legal and economic instruments to support waste management hierarchy

In the course of the years a lot of initiatives were started to improve the Estonian waste management as figure 9 shows.

Figure 9 depicts different initiatives to improve waste management from 2004 to 2010. Yet the transition of the waste management system starts already in 1990 with the transition to market economy. This caused a radical shift towards private organisations. Waste management was at that time a full part of the public sector but became quickly fully privatized. Municipalities were eventually tasked to organise the collection of waste and the definition of waste worth treating. Through tendering the private waste collection companies were found. The benefit of this cooperation is that fast investments for the equipment and management followed. The disadvantage of the cooperation was that public authorities could not monitor whether households would participate in the collection system. Thus no upswing for the waste industry could be registered. There were no incentives for municipalities to participate actively in the waste industry although the pressure rose continuously. With the fee for municipal waste disposal introduced in 1990 to remove the impurities inside the municipalities. Compared to other parts of Europe, the tax was rather small, but rose subsequently. In 2010 a ton of waste cost 12 euro, in 2013 a ton of waste cost already 17, 30 euro. Not only the tax but also the tipping ban for biodegradable waste led to illegal dumping of waste.

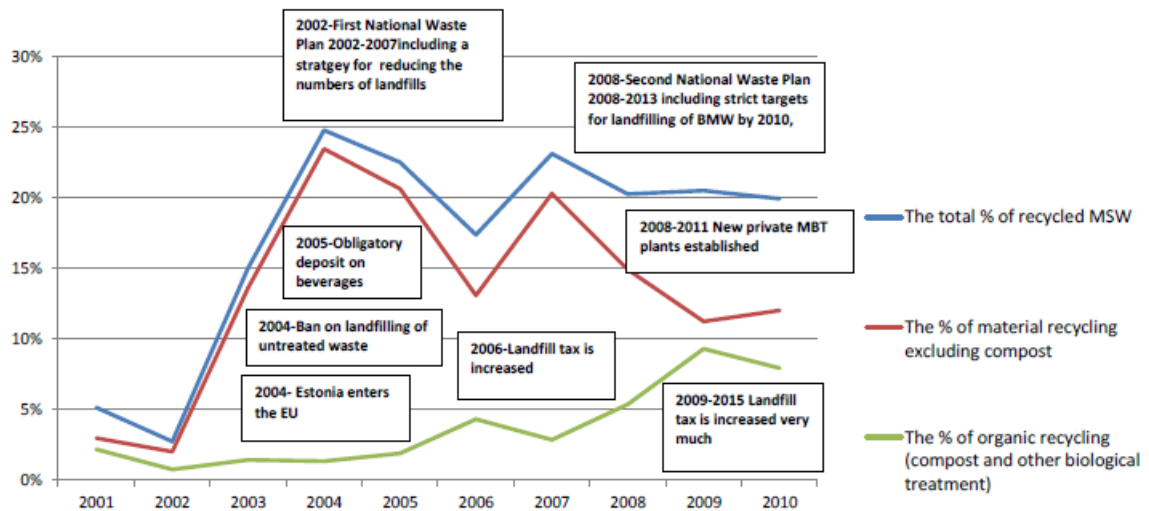


figure 10 : Recycling of MSW in Estonia and important policy initiatives [2]

The first National Waste Management Plan from 2002 until 2007 had as its main objective the harmonisation of the Estonian waste management with the specifications and waste rules of the European Union. Most important was to close outdated landfills and in return build modern landfills. Due to the first National Waste Management Plan there were for the first time objectives to detour biodegradable waste from landfills. The Waste Act subsequently banned the tipping of untreated waste. Apart from that a compulsory deposit rule for refillable and non-refillable beverage containers was passed in 2004. Depending on the type of container material there was a high return rate which amounted in 85 per cent for beverage cartons. [2]

The second National Waste Management Plan from 2008 until 2012 pursued the objective to reduce the amount of biodegradable waste on landfills. Furthermore, the objective of the first National Waste Management Plan is continued – i.e. to close old landfills and build new ones. By the end of the 1990's there were still 221 landfills. Until 2011 the number was reduced down to five landfills. [2]

#### 5.2.4 Waste management system financing

Not much is clear about the financing of the Estonian waste industry. The money for constructing new landfills and other treatment plants was mostly realised with subsidies

or tax revenues. As the communes only organise the collection of waste, the actual collection of waste is in the hands of private companies, who are also paid from the waste tax. The incurring taxes depend on the type and amount of waste. Further taxes incur as a kind of fine for uncontrolled and illegally disposed waste. This penalty tax is five to five hundred times higher than the actual waste collection fee per ton of waste.

#### 5.2.5 Public awareness, education and communication initiatives

The Estonian people had little opportunity to participate in an improved waste industry. Numbers show that the incurring waste amount has remained constant throughout the past years. Figure 7 shows also there is no improvement in recycling with a raise in landfill tax. The Estonian government has not succeeded in offering the people incentives for recycling or the necessary education.

#### 5.2.6 Barriers and success factors for waste management performance

Estonia's will to improve its waste industry has shown a positive resonance in the past years. Not only were the specifications of the EU met and biodegradable waste on landfills was reduced – but also Estonia's own objectives were met. Furthermore there are successes with an improved recycling rate, investments in composting, incineration and pre-treatment of organic waste. However, the Estonian government must give their people an incentive and the necessary education to avoid and recycle waste. Without education, Estonians will not achieve waste industry successes in the near future and not meet the standards of the European Union.

### **5.3 Literature sources**

- [1] „Das Außenwirtschaftsportal“, Zugriff am 9.10.2016 auf <http://www.ixpos.de/IXPOS/Navigation/DE/Ihr-geschaeft-im-ausland/Laender-und-branchen/Laenderprofile/Mittel-und-osteuropa/estland.html>
- [2] Fischer, C., “Municipal waste management in Estonia”, European Environment Agency, Copenhagen Resource Institute, 2013

## 6.Development of Waste Management in „old“ EU- States in the last 30 years

### 6.1 Overall Background

There are currently no data available.

### 6.2 Legal and institutional framework of waste management

Over the last 20 years, the EU has introduced a large body of waste legislation, including minimum requirements for managing certain waste types. Three targets in particular should have led to a convergence of municipal waste recycling levels across Europe: the Landfill Directive's landfill diversion target for biodegradable municipal waste; the Packaging and Packaging Waste Directive's recycling targets; and the Waste Framework Directive's recycling target for household and similar wastes.

Despite these measures, recycling levels for municipal waste differ enormously between countries. In large part, these differences can be explained by the varying initial municipal waste recycling rates in different countries; the fact that many countries joined the EU (and became subject to its waste management provisions) in 2004 or later; the existence of derogation periods for some countries; and the fact that some frontrunner countries started increasing municipal waste recycling before the introduction of EU policies or went beyond the minimum requirements.

It is also important to stress that formal transposition of EU law into national legislation is seldom sufficient to achieve the minimum target levels required by the different EU directives. In practice, additional national and regional instruments are necessary to achieve targets.

(EEA – Managing Municipal Solid Waste – a review of 32 European countries – 2013)

### 6.3 Waste management situation

The EU waste policy landscape has evolved considerably over the last 30 years. One important step was the 'Thematic strategy on prevention and recycling of waste' (EC, 2005), which resulted in a revised Waste Framework Directive in 2008 (EU, 2008). Article

4 of the directive includes for the first time a legally binding prioritisation of waste management

activities. This 'waste hierarchy' (Figure 2.1) requires that waste prevention be prioritised and promoted, and that disposal (mainly landfilling) have the lowest priority and be minimised.

The following figure presents a comparison of the share of municipal waste recycled in EEA member countries and Croatia in 2001 and 2010. Total recycling includes material recycling as well as composting and digestion of bio-waste.

In that period, 12 countries increased their recycling performance by more than ten percentage points, while 10 recorded an increase of between five and ten percentage points. This clearly indicates significant improvements in recycling performance, although the numbers also show enormous differences in performance between those countries with the lowest recycling levels and those with the highest. Clearly, countries that started the decade with relatively limited recycling (e.g. Slovenia, Poland, United Kingdom, Ireland and Estonia) are more likely to have recorded substantial improvement.

Contrastingly, several of the 'pioneers' of recycling in Europe recorded substantially slower growth, although in some cases successful measures markedly improved waste management performance even in countries with high initial percentages (e.g. Germany and Switzerland in the years 2001–2005). (EEA Report, 2013)

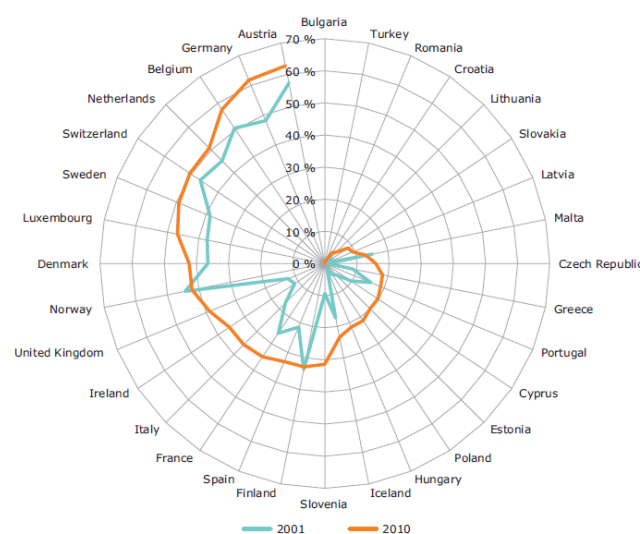


figure 11: Municipal waste recycling rates in 32 European countries in comparison 2001 and 2010 (EEA Report; 2013)

In contrast the following diagram shows the landfilling rates of the EU member states and the development from 2001-2010.

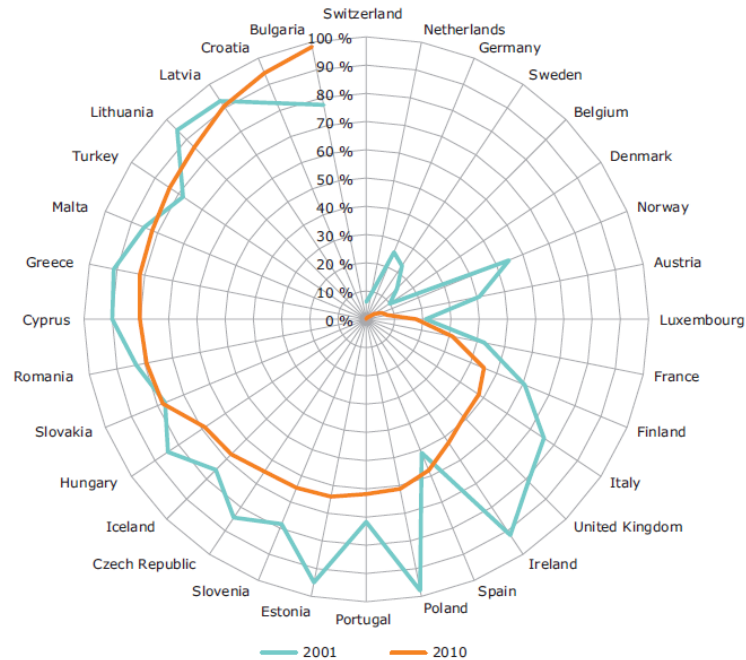


figure 12: Municipal waste landfilling in 32 European countries comparison 2001 and 2010 (EEA Report; 2013)

From the diagram it is clear visible the big differences between the EU-member states. Most countries managed to reduce landfilling in the period 2001–2010. Sixteen countries cut the percentage of municipal waste going to landfill by more than 10 percentage points, with five of them achieving a decrease of more than 20 percentage points. (EEA Report, 2013)

#### 6.4 Waste maagement system financing

The total cost is basically shifted between three channels.

- The first one (important in the past, now residual) is represented by the public budget funded by general taxation.
- The second one is represented by the service charges paid by waste producers (the citizens) to service providers, either directly (through tariffs and charges) or



indirectly (through local taxes raised by municipalities and later on earmarked to service providers).

- The third one, whose importance is increasing, is represented by those costs that are internalized by industry and charged onto consumers via product prices. The relative share varies in dependence of two basic factors.
- The first one concerns the way responsibilities are shared between service providers and EPR-based compliance schemes. In Germany, for example, the latter are organized so as to bear the full cost of the “dual system”, including separate collection. In most of the other countries, these systems bear only the differential cost (namely, the additional cost that municipal operators encounter with respect to other ways of treating waste. Therefore, the different costs of compliance schemes to industry cannot be interpreted as depending on relative efficiency.
- The second one concerns the system of economic incentives put in place with the aim of discouraging other forms of disposal (eg taxes on landfill and/or incineration). Landfill taxes are adopted in most countries; the highest fares can be found in the Netherlands (85 €/t), while Sweden, Austria, Belgium and recently the UK have set it at values above 40 €/t. In Italy, France and Spain it is in the range of 15-25 €.

## 6.5 Barriers and success factors for waste management performance

The initiatives listed below had a positive effect on improving the national waste management system of the EU member states:

- In general it can be said that countries using many regulative instruments have a higher municipal waste recycling rate than countries using very few or no instruments. Among the sixteen countries with the highest municipal waste recycling rates, twelve have used between four and seven of the selected instruments, and four have used between two and three. The ten countries with the lowest municipal waste recycling rates have all used only two or fewer of the selected instruments.
- Countries that have only regional waste management plans generally achieved good municipal waste recycling results.

- Many countries have developed more than two national waste management plans during the last ten years but the recycling performance differs greatly. This indicates that plans need to be complemented with additional initiatives to establish better recycling infrastructure or divert waste away from landfills.
- In general, countries that have increased their landfill tax by more than 50 % during the last ten years and have introduced a landfill ban on organic waste or non-pre-treated municipal waste have achieved good results. The same applies for countries with a landfill tax at or above EUR 30 per tonne of municipal waste landfilled.
- Countries that have introduced mandatory separate collection of certain municipal waste fractions, e.g. waste paper, in addition to packaging waste, or mandatory separate collection of bio-waste, have high municipal waste recycling levels. This indicates that once countries have set up separate collection schemes for at least paper, metal, plastic and glass by 2015, as required by Article 11 of the 2008 Waste Framework Directive, the recycling rates can be expected to grow significantly in many countries.
- Finally, countries using some economic incentives for households to recycle their waste (for example 'pay-as-you-throw schemes', requiring the payment of fees based on the weight of the residual (not separately collected) waste, the size of the residual waste bin or the frequency of collection) have mostly performed better than countries where waste collection fees are just based on the property value, size of the property, household size or similar.

## 7. Overview of waste management in Austria

### 7.1 Overall Background

<b>Country</b>	Austria (AT)
<b>Surface area</b>	83,872 Km <sup>2</sup>
<b>Population (thousands)</b>	8341
<b>Population density</b>	99
<b>Persons per household</b>	2.3
<b>GDP per capita PPS</b>	124
<b>GDP per capita</b>	
<b>Household characteristics</b>	40% in densely populated areas (at least 500 inhab./km <sup>2</sup> ) 24% in intermediate urbanised areas (100 - 499 inhab./km <sup>2</sup> ) 36% in sparsely populated areas (less than 100 inhab./km <sup>2</sup> )
<b>Gross value added</b>	23% Industry, including energy 7.7% Construction 23.6% Trade, transport and communication services 23.4% Business activities and financial services 20.7% Other services 1.7% Agriculture, hunting and fishing

figure 13: Country profile Austria ([http://scp.eionet.europa.eu/facts/factsheets\\_waste/2011\\_edition/factsheet?country=AT](http://scp.eionet.europa.eu/facts/factsheets_waste/2011_edition/factsheet?country=AT))

#### 7.1.1 Country profile

Currently there are no data available.

#### 7.1.2 Development of economic and environmental situation

Currently there are no data available.

### 7.2 Waste management situation in Austria

#### 7.2.1 Legal and institutional framework of waste management

The Austrian Waste Management Act was adopted in 2002 and is the main piece of legislation transposing the requirements of the WFD into domestic law. In addition, various ordinances, which are based on the Austrian Waste Management Act, support

the implementation of the WFD at national level. Further, the collection of non-hazardous municipal waste is regulated under the Waste Management Acts of the nine Austrian Federal Provinces. Therefore it has to be emphasised that in Austria requirements on separate collection are not regulated at the national level only. However this report focuses on the assessment of national transpositions, not assessing in detail whether requirements of the WFD are included in the respective Waste Management Acts of the Austrian Federal Provinces. The fact that the requirements on separate collection are further regulated on regional level has to be taken to account with regard to this assessment.

Nearly all of the single requirements from the WFD have been transposed “deviating” into national legal requirements and are included in the AWG, supplemented by its ordinances and the waste management acts of the federal provinces. As major outcome it can be concluded that in the AWG emphasis is not given to separate collection in detail (as included in the WFD) but more general information with regard to the basic principles of the waste hierarchy, including recycling (i.e. ecological soundness, technical feasibility and economic considerations shall be taken into account when applying the waste hierarchy, however it is not explicitly mentioned in the context of separate collection). The Federal Minister can determine i.e. which waste streams are to be separately collected or define requirements for treatment of waste according to the state of the clearly describes quality requirements for compost or soil originating from waste which may be stipulated through ordinances (additional information, i.e. Compost Ordinance). Separate collection targets for paper, metal, plastic and glass (to be fulfilled by collection and recovery systems) are specified, however refer to packaging waste only, additional information). The Article 22 of the WFD is transposed with additional information in Articles 1 and 2 of the Ordinance on the Separate Collection of Biogenic Waste, enforcing the separate collection of bio-waste more specifically than the WFD (i.e. mandatory separate collection, sets forth which biodegradable waste products may be collected separately provided they cannot be recovered at home or at business operations). ( EEA Factsheet Austria 2015)

### 7.2.2 Development of waste management situation and infrastructure

The total amount of waste quantities in Austria were about 56,68 million tonnes in 2014. Generally, it should be noted that the total mass is not composed merely of primary waste accumulated but also of secondary waste resulting from the treatment of

primary waste (e.g., slag and ash from the combustion of residual waste, bulky waste, residues from mechanical and biotechnological waste treatment, meat-and-bone meal, and animal fat from the processing of animal by-products as well as shredder wastes). (BMLFUW, 2015)

In the following figure the development of total waste generation (this means residual waste, biogenic waste, recyclables etc.) in Austria from 1990 to 2014 is illustrated. Until 2010 in the total amount of waste generation also residues from treatment of material e.g. wood residues, meat-and-bone meal were included. However since 2010 they are excluded from the total amount of generated waste

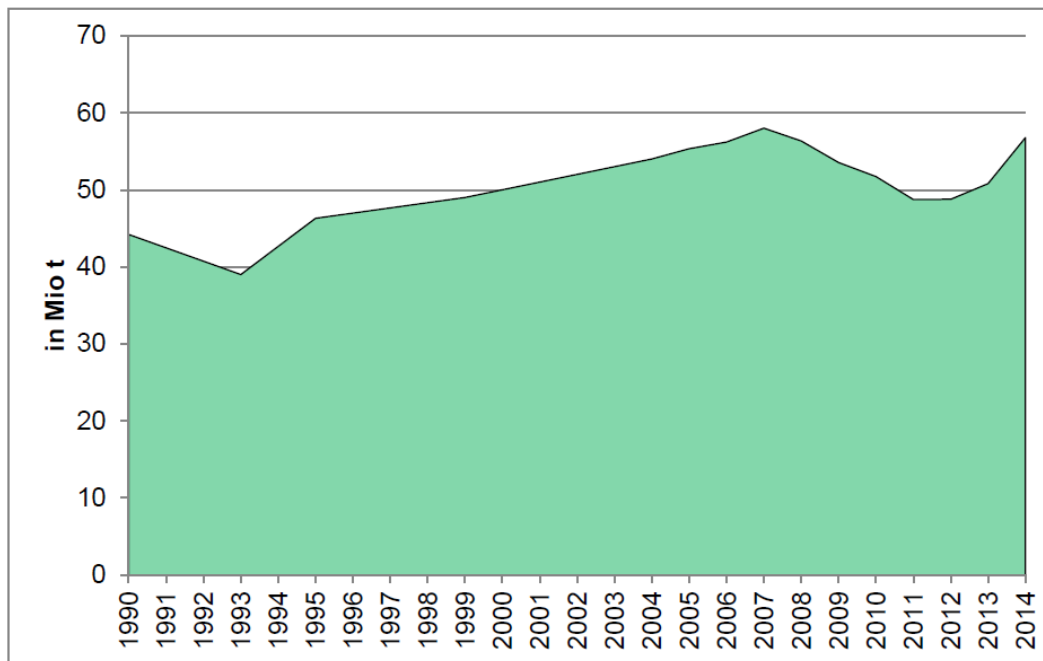


figure 14: Development of waste generation in Austria from 1990 to 2014 (BMLFUW, 2015)

As seen in the figure above the total waste generation in Austria decreased from 1990 to 1993. One reason for this decrease is the commencement of new waste management regulations in 1990. Separate collection of recyclables as well as for biogenic material and hazardous substances was extended and therefore the amount of residual and bulky waste decreased. (Salhofer, 2015)

A more detailed illustration of the different waste streams is shown in the following table.

Table 5: Selected waste streams - waste generation Austria 2009 (BMLFUW; 2011)

Selected waste streams generated in 2009 in Austria	
Waste stream	Total quantity generated
Food, beverage, and tobacco waste	836,000
Pulp, paper and cardboard waste	1,744,000
Waste of mineral origin (not including waste metal)	35,472,000
Plastic and rubber waste	626,000
Solid household waste including similar commercial waste	3,182,000
Waste for biological recovery	2,857,000
Wood waste	4,801,000
Total amount of generated waste in Austria (included all waste streams)	53,543,000

In the following illustration the development the treatment and disposal of waste from household is shown. The illustration shows development in mass percent of recovery of biogenic waste, recovery of materials from separate collection, treatment of hazardous waste, thermal treatment, biotechnical treatment and landfilling.

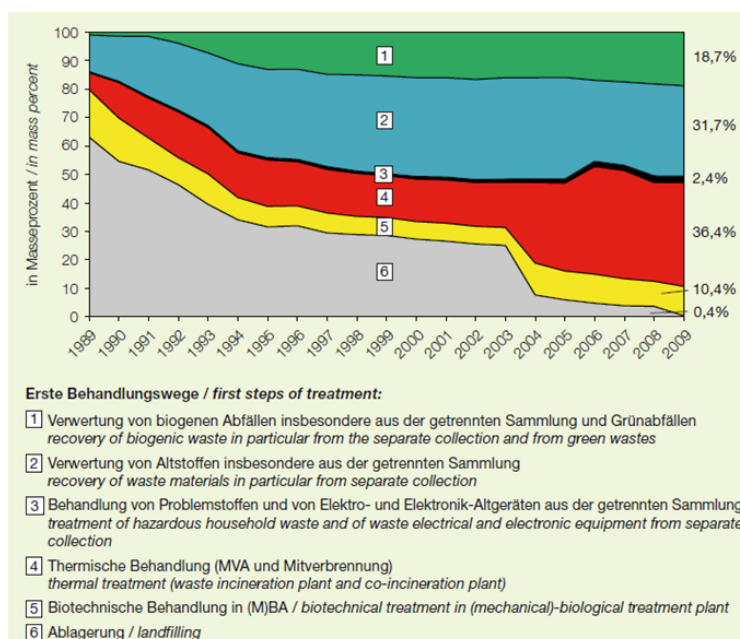


figure 15: Treatment and disposal of waste in Austria from 1989- 2009 (MNLFUW; 2012)

In the years between 2001 and 2010, the total recycling rate of MSW accounted for 55-63 % (58-64 %)1 out of which 22-30 % (21-30 %)1 was material recycling (including metal, glass, plastic, paper and cardboard recycling, but excluding composting), while composting and other biological treatment together accounted for 33-39 %. The total amount of MSW generated in Austria has increased by 7 % (1 %)1 from 4.63 million tonnes in 2001 to 4.96 (4.70)1 million tonnes in 2010. Further, Austria has reduced biodegradable municipal waste landfilled to below 3 % of the generated amounts in 1995 already by 2008.

Overview of main systems in place by type and materials collected.

#### Paper & cardboard:

- separate collection of newspapers, magazines, catalogues, brochures, writing paper, letters, etc.
- door-to-door collection: bins/containers (with red lid and label)
- bring system: bring collection points, civic amenity sites
- combination of door-to-door collection and bring system common practice, especially in urban areas

#### Glass

- separate collection of clear and coloured glass, flat glass
- door-to-door collection: bins/containers
- bring system: bring collection points, civic amenity sites
- while bottle banks are emptied up to 53 times per year in urban areas, the frequency is usually once per month in rural areas, and 16 times per year on average in Austria.

#### Packaging material

- separate collection of light-weight packaging: plastics, composite materials, textile fibres, ceramics, wood, packaging made of biodegradable material
- regional differences as regards type of collection: in some municipalities small components of plastic packaging resp. contaminated plastic packaging are collected alongside with residual waste; however easy recyclable plastic packaging

(such as plastic bottles) are collected separately everywhere; further, in some municipalities metal packaging and plastic packaging are collected together

- door-to-door collection: yellow bin/container or yellow bag (light weight packaging); yellow bags prevail in rural areas, yellow bins are used in urban areas
- bring system: bring collection points (yellow container), civic amenity sites (about 700 civic amenity sites across the country accept light-weight packaging from households)
- in addition: in some regions “(ÖKO-)BOX” or “(ÖKO-)BAG” to dispose of bonded drinks cartons (both door-to-door collection and bring system (civic amenity sites))

### Metal

- separate collection of metal packaging, beverage cans, scrap metal, ferrous metal
- regional differences as regards type of collection
- door-to-door collection: blue bins/containers: usually metal packaging only, however in some municipalities small components of non-packaging scrap metal are collected alongside with metal packaging; further, in some municipalities metal packaging and plastic packaging are collected together; bulky waste removal (especially for large components of scrap metal)
- bring system: bring collection points (blue containers as described above), civic amenity sites (especially for large components of scrap metal)

### Bio-waste

- door-to-door separate collection of biogenic waste (organic kitchen waste, plant residues and biodegradable wastes from home gardens): organic waste container has now become established throughout Austria as the predominant collection system; separate collection of i.e. left-over raw meat scraps from kitchens differs from region to region, depending on further treatment
- bring system (civic amenity site): mainly pruning and grass cuttings from home gardens
- further: home and community composting of waste that is very similar to the separately collected biogenic waste from household may be recovered at home



Relevance of "informal" waste collection

The informal collection of waste has a long history in Austria. Informal waste pickers are coming in some region of Austria since the last 25 years to look for useful materials. The main locations for the informal collection of waste are local recycling centres and collection of household bulky waste. Mainly the informal waste collectors focus on good which can be sold again in other countries e.g. furniture and electronical devices. figure 16 below show the composition of informal collected objects.

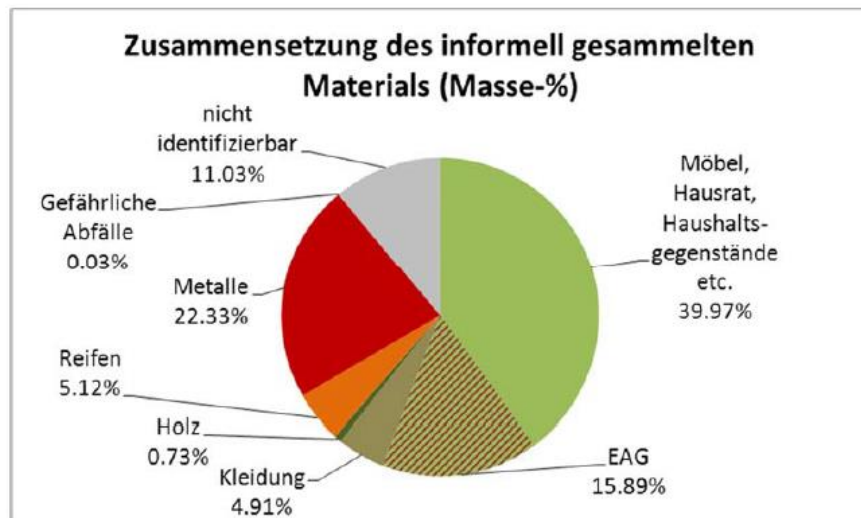


figure 16: Composition of informal collected waste in Austria (Lizner et al., 2012)

After collection goods are transported to other countries like Hungary, where they are usually repaired and sold again.

From the following figure 17 it becomes clear that a lot of Austrian municipalities are faced with informal collection activities.

Nevertheless it is difficult to estimate the effect of informal waste collection to the formal Austrian waste management system. Informal waste collectors take no records and therefore it is very difficult to estimate the informal collected capacities. In the past efforts were taken to formalize the informal waste sector like for examples through projects like Transwaste. However the informal waste sector still exists and contributed to an unknown extend to the Austrian waste system.

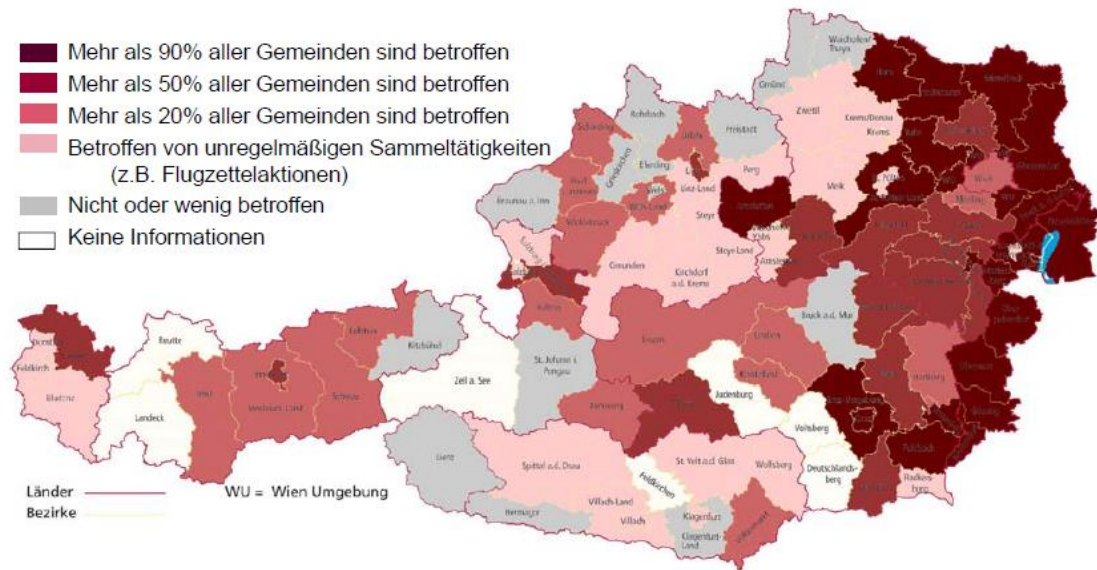


figure 17: Municipalities faced with informal waste collection in Austria (Schmied, 2014)

### Prevention and reuse rates and infrastructure

Since the early 1990s the Vienna government has financed or co-financed several hundred studies and pilot projects on waste prevention. Some best practise examples of these waste prevention strategies are listed below:

- ➔ **OekoKauf Wien (EcoPurchasing Vienna):** The city of Vienna annually purchases some EUR 5 billion in goods. 17 working groups consisting of environmental, technical and purchasing experts have developed guidelines and purchasing catalogues for the green public procurement of some 60 product groups. These guidelines are available in German language on <http://www.wien.gv.at/umweltschutz/oekokauf/ergebnisse.html>. A guideline was also prepared on the sustainable management of construction sites ([http://www.rumba-info.at/files/kurzbericht\\_rumba\\_english.pdf](http://www.rumba-info.at/files/kurzbericht_rumba_english.pdf)).
- ➔ **ÖkoBusinessPlan (EcoBusinessPlan)** provides financially aided cleaner production and eco-efficiency consultancy to Vienna enterprises. Since the start of this initiative in 1998 some 600 enterprises have received professional advice, resulting in cost savings of about EUR 34 million.
- ➔ **The Wiener Web-Flohmarkt (Vienna Web-Flea-Market)** offers an exchange platform for used goods (including cars, books, furniture etc.), construction

equipment and material, as well as gardening equipment and material on the internet.

- ➔ R.U.S.Z. (repair and service centre) provides affordable repair and tuning services for electrical household appliances. Electric goods, which are at the end or their life time, are disassembled, providing for their material recycling. Long term jobless are trained and employed in this scheme. For the future, R.U.S.Z. plans to offer also small repair services directly in the home area and to support especially elder people when dealing with the maintenance of their home equipment. ( EEA Countryprofile Factsheet Austria, 2011)

### Material recycling and composting rates and infrastructure

In Austria, there are currently 182 sorting and processing plants in regular or trial operation with a minimum capacity of at least 2.9 million tonnes. The waste can be both from separately collected recoverables (e.g. paper, plastics, wood, metal, textiles), as well as mixed waste

from households and similar establishments, as well as trade and industry. The aim of pretreatment is to separate various waste fractions and to improve waste quality in order to simplify further recovery. The methods applied are mechanical treatment (e.g. classification, sorting, ferrous and non-ferrous metal deposition) and processing methods (e.g. reduction, drying, pelletising).

The increase in number of sorting plants compared to the Federal Waste Management Plan

2006 is attributable to increased separate collection of waste intended for recovery, on the one hand, and to the requirements of the Austrian Landfill Ordinance, on the other hand, according to which waste with a total organic carbon content (TOC) of more than 5% may no longer be deposited without treatment. These requirements pertain mainly to waste streams from households and similar facilities, as well as commercial and industrial waste streams.

There are 48 plants with a minimum capacity of 1.2 million tonnes available nationwide for reclaiming materials from separately collected recoverables from households and similar establishments, as well as from trade and industry.

The following components were delivered for reclaiming materials in 2010:

- Waste paper, cardboard, corrugated board and cardboard packaging in 14 plants
- Waste glass in 6 plants
- Scrap metal (ferrous and non-ferrous metal) in 9 plants
- Recoverable plastics in 15 plants
- Waste wood in 4 plants

In another plant, several recoverable fractions are recovered, which is why the plant cannot be assigned to any item in the above list. (BMLFUW, 2012)

The following illustration shows the total number of recovery plants in Austria.

Federal Province	Number of plants	Minimum capacities tonnes/year
Burgenland	2	13,900
Carinthia	5	19,000
Lower Austria	11	323,000
Upper Austria	15	204,000
Salzburg	3	N.A.
Styria	7	585,000
Tyrol	2	N.A.
Vorarlberg	3	76,500
Vienna	–	–
<b>Austria</b>	<b>48</b>	<b>&gt;1,220,000</b>

figure 18: Recovery plants for separately collected recoverable in 2010 in Austria (BMLFUW, 2012)

In Austria separately collected biogenic waste consists of:

- plant residues and biodegradable wastes from
- home gardens, such as grass cuttings, foliage,
- flowers, windfall fruit or bulky green waste such
- as cuttings from shrubs and trees,
- organic kitchen waste, particularly from cooking
- and eating (left-over food).

In the following diagram the quantities of separately collected biogenic waste for 2009 are compared with the quantities of 2004:

Biogenic waste	2004	2009	Change
Total quantity in tonnes	546,300	752,100	+ 205,800
kg per inhabitant	67	90	+ 23
% share of total quantity generated of waste generated by households and similar establishments	16	19	+ 3

figure 19: Biogenic waste from households and similar establishments in Austria, in 2004 and 2009 (MBLFUW, 2012)

The organic waste container has now become established throughout Austria as the predominant collection system for biogenic waste (in the pick-up system). Pruning and grass cuttings from home gardens are mainly taken to existing collection points by the households.

The separately collected biogenic waste is recovered through agricultural composting (spread out on agricultural and forestry land), composting in municipal facilities, commercial composting facilities commissioned by the waste management associations, by the municipalities, or others, or by means of biogas plants.

Compost is given by the municipalities or the recovery facilities to the population and allotment associations or used for cultivation (gardens, parks, cemeteries, sports facilities, etc.) in commercial gardening operations, in landscape design or in public green areas of the municipalities. Non-recoverable residuals from separate collection or sorting of biogenic waste is incinerated. (BMLFUW, 2012)

#### Treatment and energy recovery rates and infrastructure

In Austria waste incineration is comprehensively regulated by the Waste Incineration Ordinance (Abfallverbrennungsverordnung), which in particular lays down rigid emission standards. Furthermore the pollution contents of wastes used in co-incineration plants (plants with the main purpose of energy generation or the production of material products e.g. cement plants) are subject to special limitation in order not to transfer pollutants to products or residues. (BMLFUW, 2012)

In Austria 10 municipal waste incineration plants with a total capacity of approx. 2.3 million tonnes are currently in operation. In seven plants, mainly residual waste or bulky waste is used. In three fluidised bed incinerators, mainly high-calorific fractions and sewage sludge are thermally treated.

In the figure above the 10 plants and their capacities are listed including the used waste for incineration.

Thermal waste treatment	Firing/waste use	Capacities in tonnes/year
Waste incineration plant Spittelau, Vienna	Grate firing (residual waste)	250,000
Waste incineration plant Flötzersteig, Vienna	Grate firing (residual waste)	200,000
Waste incineration plant Pfaffenau, Vienna	Grate firing (residual waste)	250,000
Waste incineration plant WAV, Wels	Grate firing (residual waste)	300,000
Waste incineration plant Dürrohr, Zwentendorf	Grate firing (residual waste)	525,000
Carinthian residual waste incineration plant, Arnoldstein	Grate firing (residual waste)	96,000
Waste incineration plant Zistersdorf	Grate firing (residual waste)	130,000
Fluidised bed furnace 4 - Simmeringer Haide, Vienna	Fluidised bed (high-calorific fraction, sewage sludge)	110,000
Residual material recovery Lenzing	Fluidised bed (high-calorific fraction, sewage sludge)	300,000
Thermal residual material recovery, Niklasdorf (ENAGES)	Fluidised bed (high-calorific fraction, sewage sludge)	100,000
<b>Total (rounded)</b>		<b>2.3 million</b>

figure 20: Plants for thermal treatment of municipal waste in Austria in 2010 (BMLFUW, 2011)

#### Landfilling rates and technical compliance of disposal infrastructure

Since 1998, the operators of landfills have been required to keep records of the amounts of waste deposited and to report this data annually to the Federal Ministry of Agriculture, Forestry, Environment and Water Management. Based on these reports we know that the 666 landfills in Austria deposit 2008 of approx. 10.7 million tonnes in 2008. (BMLFUW, 2011)

In 2008, 129,300 t of untreated municipal and similar commercial waste were deposited; this was possible until 31 December 2008 at the latest, due to a transitional period provided for in the Landfill Ordinance.

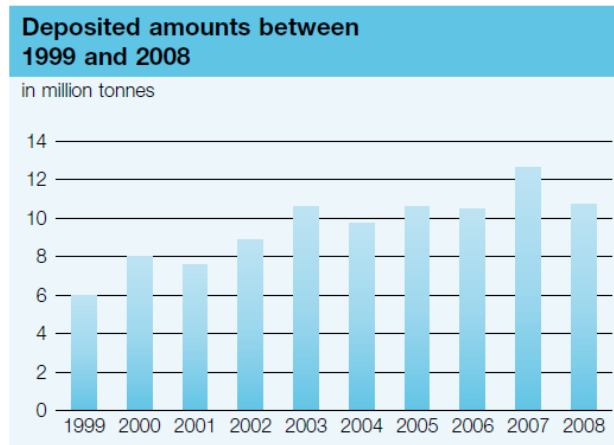


figure 21: Amounts of landfilled waste in Austria from 1999- 2008 (BMLFUW, 2011)

### 7.2.3 Legal and economic instruments to support waste management hierarchy

#### Waste management plans and targets

Austrian Waste Management Plan 2011, a list of all recycling and waste treatment facilities of the country in 2010 is available providing a complete overview on the recycling, recovery and disposal facilities as well as other waste processing facilities such as plants for sorting.

The targets of the Federal Waste Management Plan shall be based on the objectives of the Waste Management Act of 2002. Accordingly, waste management should be based on the precautionary principle and sustainability and be geared toward:

1. Preventing harmful or adverse effects on humans, animals, and plants, their life support system and their natural environment, and generally reduce any negative effects on human wellbeing to a minimum.
2. Keeping the emission of air pollutants and climate-relevant gases as low as possible.
3. Conserving resources (raw materials, water, energy, landscapes, land areas, landfill volumes).
4. Ensuring, in the case of recovery, that the materials reclaimed do not present a greater risk than do the comparable primary raw materials or products from primary raw materials and
5. Ensuring that only such waste remains as can be deposited without danger to future generations

### Waste prevention and reuse programs

Waste Prevention programs: Published in 2011, it is a plan that encompasses active measures to support the prevention of waste. Based on a vision of how the Austrian waste management sector should operate in 2020, the measures were derived from targets and action fields (food waste, re-use, construction and demolition waste).

- Food waste initiatives: The long-term aim of these initiatives is to reduce the accumulation of discarded foodstuffs in Austria. All relevant players, including producers, consumers and society at large, should contribute and sets of measures are described for each target group.
- Re-Use initiatives: Re-using products rather than replacing them with new products results in an increased conservation of raw material and energy, as well as a reduction of waste quantities. Supporting measures for the creation of the re-use sector and establishment of regional reuse networks are necessary. Furthermore measures are described to improve market penetration of reuse products and to improve the quality of re-use products and services
- Construction and demolition waste: The aim is to promote techniques and technologies to extend the use and service life of buildings, to avoid the use of hazardous substances and ultimately to reduce the amount of waste from construction. A specific ordinance is in preparation.
- waste in business enterprises
- waste in households

### Landfill bans, recycling targets

All main legislation to divert biodegradable municipal waste from landfills has been adopted in Austria before the respective EU legislation came into force. Austria has achieved a decrease to almost zero BMW landfilling following the full implementation of the landfill ban from 2004 by 2008. The Austrian strategy to divert Biodegradable Municipal Waste from landfills works with two approaches (ETC/SCP, 2009):



1. Austria has had a separate collection policy since 1992 that was introduced on biogenic waste all over the country. In 2008, about 105 kg/capita of biogenic waste was collected separately. The obligation for separate collection refers to biowaste and packaging paper waste. The separate collection is supported by additional measures. The Compost Ordinance regulates the quality of compost produced of waste with the aim to improve its competitiveness on the market while limiting environmental impacts. For paper waste (packaging as well as graphic paper) an effective separate waste collection system was installed providing separate bins almost for every house.
2. The second approach is the landfill ban for untreated waste. In Austria, the landfilling of waste with total organic carbon (TOC) content over 5 % is banned. However, there are exceptions of this ban, e.g. for the treated output from MBT. The ban came into effect in 2004 (with exemptions until 2008); this is particularly relevant to MSW, hence the strong decline in the rate of MSW landfilled from 2004 onwards.

### Recycling targets

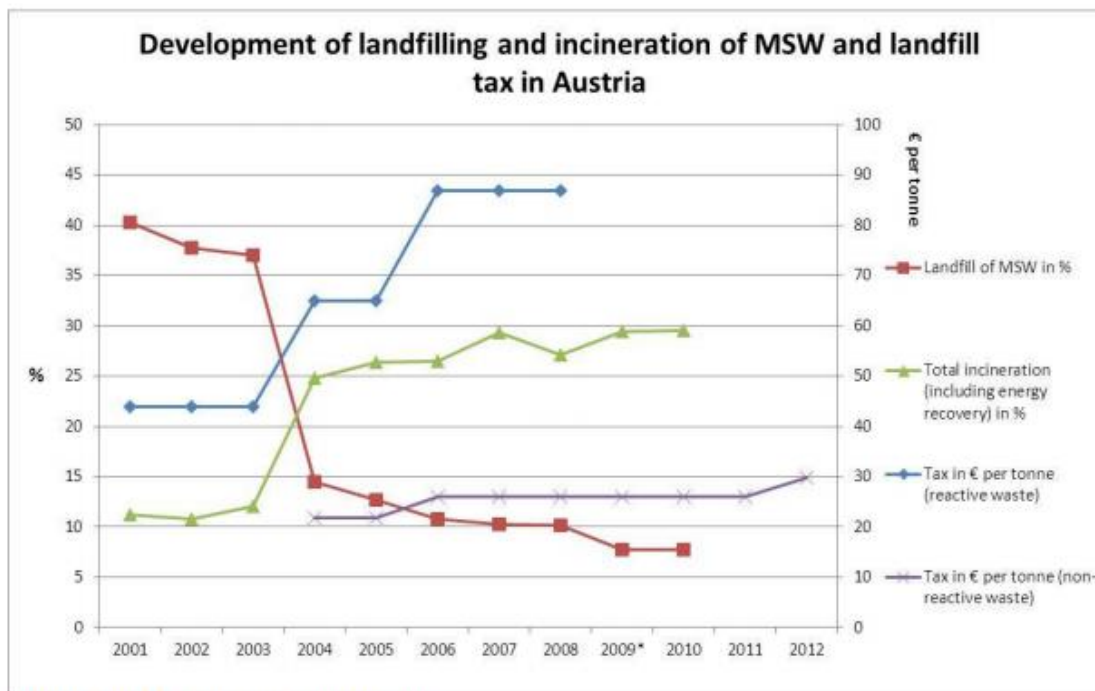
- By 2020 preparing for re-use and the recycling of waste materials such as at least paper, metal, plastic and glass from households and similar waste from - 50 % by weight;
  - By 2020 the preparing for re-use, recycling and other material recovery (including backfilling operations) of non-hazardous construction and demolition waste (excluding soil) - 70 % by weight.
- Key to the success of recycling in Austria:

The regulatory framework prescribing the requirements for a sustainable waste treatment, the implementation of economic incentives (producer responsibilities and landfill / incineration tax), regular waste controls and monitoring systems and last but not least education and training programmes as well as comprehensive information campaigns have been crucial for the successful development of the Austrian waste management.

### Taxes for waste landfilling

The Austrian landfill tax ('Altlastenbeitrag' or ALSAG-tax) was introduced in 1989 with the aim of raising revenues for the clean up of contaminated sites. Since 1996, rates have been differentiated according to the technical quality of the landfill site and to the type of waste landfilled.

In the period 1996 to 2008 sites with lower technological standards, e.g. without landfill gas capture, paid a much higher rate than landfills with state-of-the-art technology. The "low-standard-landfills" were phased out by 2008 so that the respective tax rate is not applied any more. The 'Altlastenbeitrag' was extended in 2006 to cover incineration (ETC/SCP, 2012).



Source: ETC/SCP, 2012 and Eurostat, 2012.

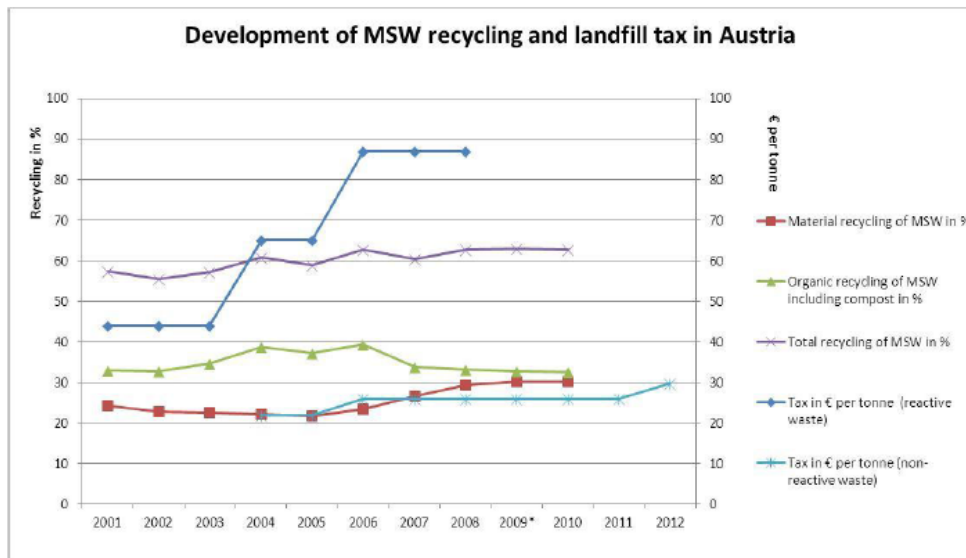
Note: According to comments from the Austrian UBA, in the reports to Eurostat, the biologically treated output from MBT was allocated to the category 'compost'. In reality this output (271 000 tonnes in 2009 or 7 % of the MSW generation) are not compost but waste to be landfilled. Thus, 7 % of MSW generation is deducted from organic recycling and added to landfilling for all years on all relevant graphs.

figure 22: Development of landfilling and incineration of MSW and landfill tax Austria

ALSAG - landfill tax for municipal waste in €/t	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Tax for non-reactive waste (fulfilling the conditions of Massenabfalldeponie)	na	Na	na	21.8	21.8	26	26	26	26	26	26	29.8
Tax for other (reactive) waste on compliant landfills	43.6	43.6	43.6	65	65	87	87	87	87	na	na	na
Tax for other (reactive) waste on non-compliant landfills	72.7	72.7	72.7	94	94	116	116	na	na	na	na	na

Source: Altlastensanierungsgesetz (BGBl 1989/299) in the versions valid during the respective years. Vienna

figure 23: Landfill tax in Austria



Source: ETC/SCP, 2012 and Eurostat, 2012

Note: According to comments from the Austrian UBA, in the reports to Eurostat, the biologically treated output from MBT was allocated to the category "compost". In reality this output (271 000 tonnes in 2009 or 7 % of the MSW generation) are not compost but waste to be landfilled. Thus, 7 % of MSW generation is deducted from organic recycling and added to landfilling for all years on all relevant graphs.

figure 24: Development of MSW recycling and landfill tax in Austria (EEA Municipal waste management in Austria, 2013)

The strengths of the landfill tax include:

- It can be adapted to the varying environmental impacts of different waste types and treatment options. It is therefore a good instrument for driving waste management further up the waste hierarchy;
- Costing on average less than €10 per citizen per year the landfill tax is affordable whilst applying the polluter pays principle and therefore provides a (small) incentive for reducing waste generation; and

- The tax raises around €50 to 80 million per year to be spent on the actual remediation of contaminated sites.

The weaknesses of the landfill tax include:

- It is difficult to define the level of the tax where the effect of pushing waste up the waste hierarchy is achieved whilst market barriers are avoided (VOEB 2007); (European Commission DG ENV, 2012: Use of Economic Instruments and Waste Management Performances )

### Biowaste diversion from landfills

The Austrian strategy to divert Biodegradable Municipal Waste away from landfills works with two approaches.

Biodegradable municipal waste shall be collected separately in order to allow for recovery operations producing high quality products. The obligation for separate collection refers to biowaste and packaging paper waste. The separate collection is supported with additional measures. The Compost Ordinance regulates the quality of compost produced of waste with the aim to improve its competitiveness on the market. Recycling targets for packaging paper waste can only be reached, if a proper collection system is installed.

The second approach is the ban of untreated waste going to landfills. Waste with TOC above 5% has to be either incinerated or pre-treated in mechanical biological facilities.

The two approaches are supplemented by a fee for the landfilling of waste. The objective of this fee is to finance the remediation of contaminated sites. The amount of the fee depends on the type of waste and the technical quality of the landfill. One side effect of the fee is that the price for landfilling is increased, so that waste streams are redirected to other waste management routes.

### **Regulatory instruments:**

- Separate collection of biowaste (1995)
- Separate collection of packaging waste (1997)

- Ban on landfilling (1997)
- Fee on landfilling of waste (ALSAG-fee)

#### *Pay-as-you-throw-system (PAYT)*

Waste management fees in Austria must be based on the size of a household's residual waste bin and the frequency of emptying. Fees for the collection and treatment of household waste must also correspond to the costs of the services rendered, as opposed to being profit-oriented. The fee levied per household is typically comprised of a system charge (which is used to finance waste management activities, such as the removal of litter) and a treatment charge covering the costs of waste collection and treatment. The setting of fees falls under the competence of the relevant Federal Provinces; they are not set at the national level. As permitted by law, most municipalities have formed waste management associations through which the collection and treatment of all waste is facilitated.

#### Impacts of PAYT schemes in Austria:

Waste collection and treatment fees collected by Austrian municipalities increased from €72 per household in 1995 to €155 per household in 2006, due to a 23% increase in waste generation per household and the conversion of a landfill based waste disposal system to a recycling/incineration/biological based waste management system, which provides for the collection of different categories of household waste.

(European Commission DG ENV,2012: Use of Economic Instruments and Waste Management Performances)

#### *Extended Producer Responsibility (EPR)*

Dual model (Austria, Germany, Sweden): Industry has full operational and financial responsibility over collection, sorting and recycling. There is a separate collection system designated to local authorities but their influence is minimal.

MS	Batteries	WEEE	Packaging	ELV	Tyres	Graphic paper	Oils	Medical waste, old/unused medicines	Agricultural film
AT	x	x	x	x	x	x	x	x	

figure 25: Existing extended producer responsibility schemes

Example:

In Austria: For the collection of portable batteries the PROs cooperate with regional partners, which are either communal waste management organisations or private companies. For the pick-up and transport of the battery boxes filled at the point of sale a pick-up service is organised by the PROs.

In Austria, a car owner has several options to give back his vehicle:

- ➔ official take-back points of the producers/importers or PROs;
- ➔ car dealers, which are not producers/importers (e.g. while buying a new car);
- ➔ collection or treatment companies, which are not part of the collective system.

(European Commission, 2014: Development of Guidance on Extended Producer Responsibility)

Example ARA:

ARA AG was founded in 1993 by key Austrian companies who wished to fulfil their obligations arising from the Packaging Ordinance as efficiently as possible. Up until mid-2008, ARA System consisted of ARA AG and eight recycling organisations in charge of organising the environmentally sound and cost-efficient collection, sorting and recovery of the different packaging materials. With effect from 1 October 2008, all affiliates – with the exception of AGR (glass recycling) – were merged with ARA AG to further improve the system's efficiency and flexibility. AGR remains a legally independent entity, but continues to be part of ARA System.

All domestic and foreign producers, importers, fillers and distributors of packaging can sign a compliance and licence agreement with ARA AG. Under this agreement, they report all quantities of packaging they put into circulation to ARA and pay the correspond-

ing licence fees, while at the same time transferring to ARA the legal obligations stipulated by the Austrian Packaging Ordinance for these quantities of packaging. ARA licence partners are entitled to use the “Green Dot” on their packaging

ARA is a full cost system. In order to provide a nationwide collection, sorting and recovery service in Austria, ARA concluded agreements with more than 450 Austrian municipalities and waste management associations, with over 200 waste management companies and with numerous recyclers. ARA also supports the activities of some 250 waste consultants throughout Austria by means of personnel cost subsidies and project funding. These advisers perform important public relations work in that they provide consumers with information, and thus make a significant contribution to the public acceptance of separate collection. (PROE, PRODUCER RESPONSIBILITY IN ACTION)

#### 7.2.4 Waste management system financing

- Tax system
  - ➔ For any waste type
  - ➔ For special purposes (e.g. landfill tax for contaminated site remediation)
  
- Fee system
  - ➔ In general (e.g. municipality sets certain fee and charges residents for residual waste per household, per square metre living space)
  - ➔ For specific purposes (e.g. integrated disposal fee for refrigerators, fluorescent tubes)
  
- Deposit System
  - ➔ For certain waste types (e.g. glass bottles, plastic bottles)
  
- Full cost system (all services covered)
  - ➔ For certain waste types (e.g. Producer responsibility driven systems for packaging, electric/electronic waste)
  
- Additional Cost system
  - ➔ For certain waste types (stakeholders share costs involved for packaging waste)

Inhabitants of Vienna	1.752.365
approx. inhabitants per household	2,21
specif. costs per household and year (without offices, small trade etc.)	164 €
specif. costs per household and day (without offices, small trade etc.)	0,45 €
specif. costs per inhabitant and day (without offices, small trade etc.)	0,20 €

figure 26: Costs of waste management (Vienna)

### 7.2.5 Public awareness, education and communication initiatives

Currently there are no data available.

### 7.2.6 Barriers and success factors for waste management performance

Key barriers and difficulties in Austria's waste management are caused through the fact that responsibilities are shifted through many stakeholders. On the hand we have the national law, the state law and the municipal law. And additionally on the other hand in Austria EU legislation has to be taken also into account. This leads to that in Austria's 9 federal states no equal standard is reached and different federal laws are valid.

Looking back in Austria past of waste management it can be seen clearly that Austria had made a great success in recycling, energetic use of waste and waste treatment. Furmermore it had achieved big success in the separate collection of waste and has on of the highest recovery rates in the EU. (BMLFUW, Nachhaltige Abfallwirtschaft in Österreich, 2014)

The waste avoidance programme 2011 makes use of the experiences with the implementation of local, regional and federal waste avoidance initiatives gained in many fields and is based on the results of the waste avoidance and recovery strategy 2006 as well as on the requirements of the Waste Framework Directive. The waste avoidance



programme aims at decoupling the environmental effects related to the volume of waste generated from economic growth.

The waste avoidance programme 2011 is primarily a plan of active measures supporting

waste avoidance and all parties involved are invited to participate in the realisation of the existing waste avoidance potentials.

The following measures have been taken to improve the waste prevention:

- Avoidance of demolition waste
- Waste avoidance at company level
- Waste avoidance at household level
- Food waste prevention
- Re-use

Besides the above listed measures also binding provisions were taken for batteries, cooling appliances, lamps, lubricants, end-of-life vehicles as well as end-of-life electrical devices. They have been adopted in order to ensure separate collection and the isolation of harmful substances. Within the framework of these provisions producers are obliged to ensure separate collection and environmentally compatible recovery. The branches of industry concerned have, taking over their producer responsibility for the purposes of an efficient way of collection and recovery, established "comprehensive area-wide disposal systems".(BMLFUW, 2012)

Also strong regulations for landfills played an important role in Austria waste management strategy. The Landfill Ordinance (Deponieverordnung) is of particularly high importance, as it contains detailed requirements on the sites and technical equipment of landfills as well as ceilings for the pollutant content and the reactivity of the wastes to be deposited. The landfilling of wastes with a high share of organic substances is prohibited. Residual waste from which the separately collected recyclable materials have been removed is energetically used in waste incineration plants with a high technical standard. (BMLFUW, 2012)

Least but not lost a very important success strategy was the implementation The Law on the Remediation of Contaminated Sites (Altlastensanierungsgesetz). The Model of Remediation of Contaminated Sites which has been established in Austria for more than 20 years is unique in international comparison and attracts great attention on a global scale. In the whole EU area there is no comparable financing model, which allocates assigned charges from waste management to the remediation of contaminated sites. In this way a reliable protection of the population and of the environment and/or a speedy identification and mitigation of old environmental sins is guaranteed. (BMLFUW, 2012)

## 8. Overview of waste management in Denmark

### 8.1 Overall background

Currently there are no data available.

#### 8.1.1 Country profile

Currently there are no data available.

#### 8.1.2 Development of economic and environmental situation

Currently there are no data available.

### 8.2 Waste management situation in Denmark

#### 8.2.1 Legal and institutional framework of waste management

Denmark was the first country in the world with implemented in 1973 already an environmental protection law. The Environmental Protection Agency (Miljøstyrelsen) is part of the Ministry of Environment and Food and issues relevant waste management regulations.

The overall legal framework regarding waste management is mainly found in part six of the Danish Environmental Protection Act (Miljøbeskyttelsesloven). The Statutory Order on Waste (Affaldsbekendtgørelsen) is the most central one. Besides this there are decrees of producer responsibility, incineration and landfilling. The Environmental Protection Agency (EPA) issues regulations to complement the existing laws and decrees.

The Danish waste model is based on a combination of traditional administrative instruments (acts, orders, circulars), and various economic instruments covering taxes and charges as well as subsidy schemes and agreements. (European Commission - National Factsheet Denmark - 2015)

The National Waste Strategy 2009-2012 is largely based on the waste hierarchy and presents a three pillar approach to Danish waste policies; resource policy, climate policies and protection of the environment and human health. The Danish Waste Strategy has a target to recycle at least 65 % of the total waste and to landfill at the most 6 % of the total waste amounts in 2012.

The second part of the strategy – Waste Strategy '10 – was issued in June 2010, and includes a number of initiatives to increase waste prevention and encourage development of new waste treatment technology. The challenge is to generate less waste and at the same time develop new technologies which can utilize the materials in the waste. Waste prevention and food waste is the focus of nationwide information campaigns ([www.brugmerespildmindre.dk](http://www.brugmerespildmindre.dk) and [www.mindremadspild.dk](http://www.mindremadspild.dk)), started within the frame of the waste strategy.

The municipalities have a statutory responsibility for waste planning. They have to prepare a waste management plan every four years, making sure that waste management reflect the national waste strategy and is carried out in line with the waste hierarchy. The plans are valid from four to twelve years. The municipal waste planning should include all waste, including waste that is not subject to municipal liability. The municipal waste management plans play a central role in the development of waste management in the country. (Reco Baltic 21 tech, 2012)

In Denmark two different waste management schemes can be introduced. The first one is the allocation schemes ('anvisningsordning'), under which the waste producer is responsible for making sure that waste gets delivered at an appointed place for handling. The second one is a collection schemes ('indsamlingsordning') in which the municipality is responsible for the waste treatment, the door-to-door collection and bring points. The Environmental Protection law also stipulates that when municipalities establish a waste collection scheme, no other competing scheme can be set up.

Every municipality has the right to decide on the collection scheme as well as the obligation to secure the necessary processing capacities for collected waste. Recycling capacity is in many cases secured by agreements with private recycling companies or through inter-municipal companies. (European Commission - National Factsheet Denmark - 2015)

The "Danish Waste model" was developed in the 1980s and places all the responsibility on the municipalities. Municipals have the responsibility of collection, recycling and disposal of the waste in their jurisdiction. Recyclable business waste was excluded in

2010. The municipalities have to provide separate collection of packaging and newspapers in densely populated areas and they have to inform the public about management of the waste covered by the producer-responsibility. The Danish Waste model is based on "allotment rights" that indicate which waste facility should be used for treatment of the waste.

Large municipalities typically choose to manage waste themselves, whereas most small municipalities cooperate in inter-municipal waste companies. Around 60-70 per cent of municipalities conduct collection and/or treatment of household waste by a regional organization, waste association or inter-municipal company.

Most of the Danish municipalities are too small to be able to handle the waste treatment tasks in an economically viable manner. According to Tojo the government has a strong preference for privatisation. The operations are often outsourced to transport and sorting companies. The flexibility of each municipality to choose solutions suitable for the locality is somewhat hindered when private entities carry out the task on competitive basis. The privatisation would also mean the in-flow of cheap labour from other countries. The waste transport is procured with open tender at the EU level and it is difficult for Danish local waste haulers to win the prize competition.

Most incinerators are operated by municipalities and inter-municipal companies. Landfills for household waste are to be legally operated by the municipality. When landfills are used there are usually other treatment facilities operated by the municipality nearby, such as sorting or composting.

Supervision of the waste management sector is carried out by the municipalities or by the Environmental Protection Agency (EPA) through five regional organizations.

The Environmental Protection Agency (EPA) is organised in nine units. One of the units is the Danish EPA Soil and Waste in is responsible for waste related topics.

### 8.2.2 Development of waste management situation and infrastructure

	2005	2006	2007	2008	2009
Municipal waste generation per capita, kg	720	727	779	824	760
Municipal waste generation, thousand tonnes	3990	4021	4313	4560	4206

figure 27: Municipal waste generation in period 2005- 2009; Denmark ([www.stat.see](http://www.stat.see))

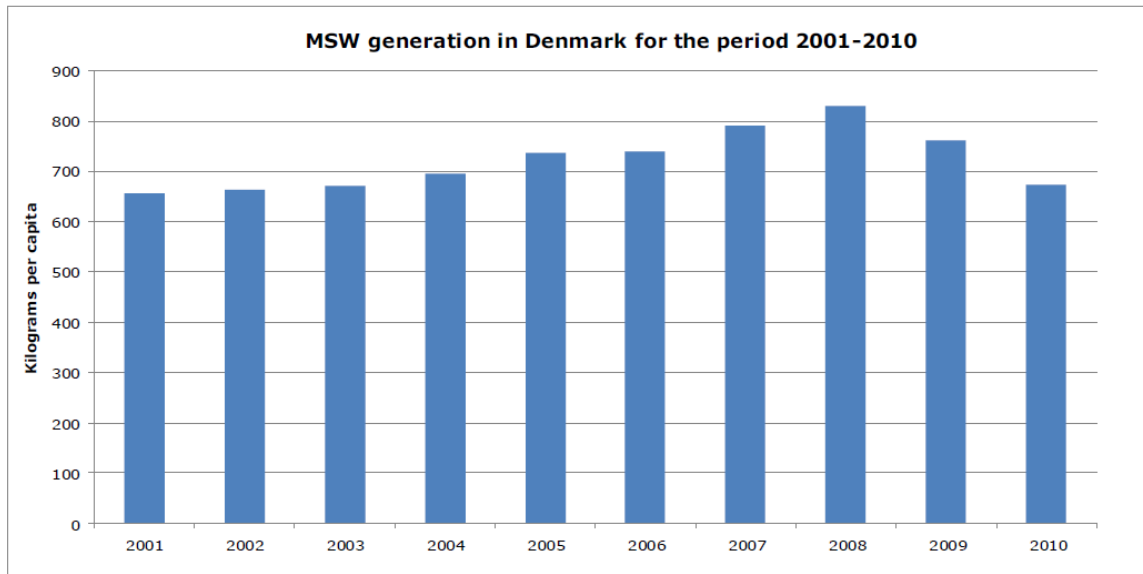


figure 28: MSW generation per capita in Denmark (Eurostat, 2012)

Denmark defines municipal waste as all waste from households as this waste is always collected by a municipal collection scheme and in addition fractions similar to household waste from the primary source 'Institutions, Commerce and Offices' as these fractions are also collected by a municipal scheme in Denmark (Marcher, 2005).

The generation of MSW in Denmark (figure 28) topped in 2008 with 830 kg/capita and has since decreased to 762 kg/capita in 2009 and to 673 kg/capita in 2010 based on Eurostat data.

The larger decline of 12 % in MSW generation per capita from 2009 to 2010 (figure 28) is due to change in the waste regulation per 1 January 2010 (Statutory order on waste 2010), which changed the definition of waste regarded as MSW. All enterprises are responsible for recycling of their recyclable waste under the new regulation. In the past, the municipalities had more duties and authorities regarding recyclable waste from private enterprises. The change in regulation resulted in the municipalities no longer having responsibility for ensuring that sufficient recycling capacity is available either at publicly or privately owned plants for waste from institutions, commerce and offices. (EEA- Municipal Waste Management in Denmark, 2013)

	2000	2002	2004	2006	2007	2008	2009
Paper, paper packaging	181	204	221	211	246	207	221
Glass	83	111	88	85	91	65	98
Plastic	2	5	4	4	5	4	5
Metal	17	25	25	31	76	410	313
Green kitchen waste	45	37	53	41	43	38	50
Garden waste	505	512	495	592	640	527	611

figure 29: Main waste fractions of household waste collected for recycling (1000 tonnes) in Denmark (EEA -Municipal Waste Management in Denmark, 2013)

- **Collection coverage and source-separate collection rates and infrastructure**

The waste management system in Denmark differs from many other countries in EU because the municipalities are in principle responsible for the entire waste stream generated from their jurisdiction regardless of the source. This includes drugs, newspaper and packaging material from the households as well as industrial and commercial combustible waste and residual waste for landfilling. Sorted recyclable materials from the private sector are not included in

the responsibility of the municipality. 80 percent of the municipalities hire contractors for the collection of waste. There are a few large nationwide collection contractors and some regional actors.

Collection of food waste from households is not common in Denmark. Biological treatment has mainly focused on green waste and composting, but it is increasing. Collection of foodwaste and anaerobic digestion is however increasing.

Municipalities are required to offer curbside or bring collections for paper and glass. If the collection rate of newspapers and cardboard is less than 60 percent the municipality must offer curbside collection according to the public law. Once introducing curbside collection the municipality must no longer achieve the target of 60 percent.

All municipal systems have recycling centers for the collection of bulky waste and hazardous waste. Municipalities usually offer curbside collection of bulky waste, which is a widely used service that relieves the recycling centers. Curbside collection of hazardous waste is less common. In multifamily areas there are often dedicated spaces for bulky waste, not as often for hazardous waste.

The producer responsibility includes batteries, electronic waste, tires and cars. The municipalities are not responsible for waste streams covered by the producer responsibility or other specific regulations, such as end-of-life vehicles, construction and demolition waste, biomass waste, EEE and containers for beer and soft drinks managed by

a mandatory deposit-refund system. The collection and recycling of waste in the producer-responsibility category is organized by various companies responsible for the waste categories. The companies hire contractors to perform the collection.

- **Relevance of “informal” waste collection**

The informal waste collection plays no important role in the Danish waste management system.

- **Prevention and reuse rates and infrastructure**

The Danish Government launched a waste prevention strategy in 2013 with the aim to raise recycling rates and therefore to reduce the production of primary materials. The focus of this strategy is to produce more eco-friendly designs products and a more resource efficient society, which means that resources are being used effective and not waste useless. Seven target fields were selected in which the Danish Government set initiatives for waste preventions. The seven fields and some of the government’s activities are listed in the table below.

1. Transition in Danish business
  - New loan options for businesses via the Danish Green Investment Fund
  - An innovation forum for green solutions and sustainable production
2. Green consumption
  - Expand the “Mind the Trash” teaching material for schools about resource-efficiency and waste
  - Quick guide to green everyday choices (Miljøvejviseren – den nemme vej til en grøn hverdag), an official one-stop-shop
3. Less food waste
  - A team of ‘food waste hunters’ will offer their assistance in the public and private food service sectors
  - Support the development of a global protocol for defining, measuring and reporting food waste
4. The construction sector



- Tightened requirements for demolition of buildings and for the qualifications of demolition companies
- A platform for showcasing green solutions that already exist in the market
- 5. Clothing and textiles
  - A partnership to “prolong the life span of your clothes” between businesses and organisations
  - A study of micro plastics, e.g. in textiles and cosmetics, which lead to the accumulation of plastic waste in the marine environment
- 6. Electrical and electronic equipment
  - Quantification of environmental benefits from reuse and repair of selected fractions from waste electrical and electronic equipment
  - Campaign about the content of mercury in energy-saving bulbs and about alternatives to these, e.g. LED
- 7. Packaging
  - An inspection campaign targeted at selected types of packaging
  - Information campaigns and subsidies for development and demonstration of environmental technologies to increase the rate of recycling and establish more closed-loop value chains for packaging waste (Danish Government, 2015, p. 52)

- **Material recycling and composting rates and infrastructure**

The amount of waste recycled through material recycling increased more or less steadily since 2000 with a jump from 130 kg/cap in 2007 to 201 kg/cap in 2008, followed by a fluctuation until it reached 215 kg/cap in 2012, the year with the latest available data at Eurostat. In the same period, the quantity of composted and digested waste increased from 84 kg/cap in 2001 to 136 kg/cap in 2007 and fell again to 87 kg/cap in 2011 and 2012.

The recycling rate of municipal waste, which includes both material recycling and biological processing, has increased from 30.8% in 2001 to 43.7% in 2009, decreased by a few percentage points in the following years and reached 45.2% in 2012 [DK Eurostat 2014 1,2].

In 2011, before the obligatory establishment of waste management plans, roughly 22% of paper, cardboard, plastic, glass, metal, wood and organic waste were sorted, which means that a double that amount was necessary to meet WFD's goal in 2022 [DK NWMP 2014, p.17].

There are several options for collecting many of the waste streams and their availability may differ between municipalities. Collection schemes for paper and cardboard have to be established in settlements with more than 1 000 inhabitants, and for recyclable glass packaging waste in settlements over 2 000 inhabitants. Collection schemes for recyclable metal and plastic packaging waste also have to be established.

Glass, paper, cardboard, plastic and metal waste can either be collected at bring points or at civic amenity sites. In some municipalities, the collection of bulky waste is established, where glass, cardboard and metal waste can be disposed of. Glass can also sometimes be collected by door-to-door system, which increases the collection rate.

Civic amenity sites are managed by municipalities that decide on the types of waste that citizens can deliver. With the exception of food waste and mixed household waste, most of the other waste streams can be deposited at these sites.

Most organic waste is not sorted out of household waste and therefore ends in an incinerator. A number of municipalities have however established separate collection systems where source-separated organic waste is used for the production of biogas and fertiliser in biological treatment facilities. Some municipalities collect green/garden waste from houses for controlled bulk composting. Bio-waste can also be home-composted by citizens. Some municipalities offer support in terms of e.g. guidance or containers for composting.

The collection of composite material (beverage packaging) is administered by the company Dansk Retursystem A/S, obliged by law to secure collection free of charge [DK RET 2013, p.7]. Certain types of glass bottles have been included in the deposit-refund system since 1942 and other types of beverage containers – plastic bottles and cans – were added later. (EU Commission – DK Factsheet -2015)

- **Treatment and energy recovery rates and infrastructure**

The shift towards incineration and composting started already in the 1980s when the space for landfills was scarce.

In Denmark incineration is the main method of waste disposal (53 per cent). County governments currently provide licenses for incineration plants. Decentralised EPA-centres have the responsibility for larger incinerators while municipality offices provide for smaller incinerators. The gate fee for waste-to-energy facilities in Denmark is one of the lowest in Europe with 27 euro per tonne of waste, excluding taxes and VAT. The extensive energy recovery and the efficient facilities make it possible to have such a low gate fee.

Incineration and waste-to-energy is the main method of treatment today. Denmark is the world leader when it comes to incineration. The plants are connected to the energy grid providing district heating and electricity to the Danish market. The plants decrease the volume of the waste by up to 70 per cent. More incineration plants are planned. Biological treatment is growing and anaerobic digestion is becoming more common. Around 1 million tons of organic household waste go to incineration every year. This waste stream needs to be diverted to biological processes. Improving the recycling rates is the main concern in Denmark.

Denmark has a relatively small biogas market compared to other European biogas markets. Despite this, Denmark plays an important role in the biogas technology sector with the per capita production of biogas as the fifth highest in Europe. The agriculture sector has had a positive influence of this sector. Denmark has the world's biggest test facility at the University of Aarhus and the biggest biogas production facility, Maabjerg Biogas.

- **Landfilling rates and technical compliance of disposal infrastructure**

Most landfills in Denmark are owned by the municipalities. Denmark has a low dependency on landfill and a high level of waste recovery. 2011 approximately 4 per cent of the household waste was landfilled. In the period from 1985 to 2008 the absolute reduction in waste for landfilling from households was equivalent to 77 %. The Danish Landfill tax was introduced in 1987 along with the introduction of a tax on incineration. The aim was to create an incentive to help reduce the amount of waste going to landfills and incineration plants and to promote recycling. The tax had a significant reduction effect on types of waste that have a large weight and are reasonably homogenous, e.g. construction and demolition waste and garden waste. 39 Denmark was the first country in the world to ban landfilling of waste suitable for incineration, in 1997. This

ban, together with the landfill tax has played a significant role in the shift away from landfilling.

According to the EU Landfill Directive, it is a general requirement that all Member States have to reduce the amount of biodegradable municipal waste landfilled (BMW) with a certain percentage by 2006, 2009 and 2016. Denmark has reported the landfilled amount of BMW to the Commission for the year 2006. The amount of BMW landfilled is far below the targets for 2006, 2009 and 2016. The amount landfilled in 2006 was 2 % of the BMW generated in 1995.

In 1997, Denmark implemented a landfill ban on biodegradable MSW. Denmark reported to the EU Commission in 2009 that the amount of biodegradable MSW in Denmark has been for many years 1-2 % of the amount landfilled in 1995 (EEA, 2013)

### 8.2.3 Legal and economic instruments to support waste management hierarchy

#### **Waste management plans and targets**

The first national waste plan (1993-1997) was developed in 1992. In the subsequent waste plans for 1998-2004, 2005-2008 and 2009-2012, the recycling targets were revised and also waste prevention and actions diverting generated waste from landfills were addressed.

The second national Danish Waste Plan 1998-2004 (Waste 21) set a target of 60 % recycling of paper and cardboard waste from households. Municipalities were obliged to introduce separate containers at each household for paper waste if the municipalities were performing under a certain collection. The potential in tonnes is huge. However, the data for collected paper from households have been quite stable from 2000 to 2009. During the last decade the recycling centres for household waste run by the municipalities have been expanded and more waste types can be delivered at the recycling centres. (Kjær, B. (2013): Municipal waste management in Denmark)

The third national Danish Waste Plan 2005-2008 implemented the targets in the EU Directive for packaging and packaging waste to be fulfilled in 2008. A few initiatives focused on municipal waste. The municipalities had to implement collection schemes for metal packaging and certain types of plastic packaging. The introduction of a deposit system for one way beverages packaging in 2002 increased the amount of plastic and metal packaging waste and the amount of recycling. However, the potential in tonnes

for these schemes are quite small and it is not expected to influence the total recycling of municipal waste. (Kjær, B. (2013): Municipal waste management in Denmark)

The National Waste Strategy 2009-2012 is largely based on the waste hierarchy and presents a three pillar approach to Danish waste policies; resource policy, climate policies and protection of the environment and human health. The Danish Waste Strategy has a target to recycle at least 65 % of the total waste and to landfill at the most 6 % of the total waste amounts in 2012.

The second part of the strategy – Waste Strategy '10 – was issued in June 2010, and includes a number of initiatives to increase waste prevention and encourage development of new waste treatment technology. The challenge is to generate less waste and at the same time develop new technologies which can utilize the materials in the waste. Waste prevention and food waste is the focus of nationwide information campaigns, started within the frame of the waste strategy. (RECO Baltic 21 Teach (2012): National Waste Management Review. Sweden. Germany. Denmark. Finland)

The municipalities have a statutory responsibility for waste planning. They have to prepare a waste management plan every four years, making sure that waste management reflect the national waste strategy and is carried out in line with the waste hierarchy. The plans are valid from four to twelve years. The municipal waste planning should include all waste, including waste that is not subject to municipal liability. The municipal waste management plans play a central role in the development of waste management in the country.

In 2013, the Danish Government published a plan entitled 'Denmark without waste – Recycle more, incinerate less'. The plan contains the former government's overall objectives for waste management in Denmark within the next 10 years. The Government has now set a goal that in 2022 Denmark will be recycling 50% of household waste. The main focus of the plan is to consider waste as a resource to be recycled.

(The Danish Government (2013): Denmark without Waste. Recycle more – incinerate less)

The Resources Strategy for Waste Management – Denmark without Waste has the following initiatives:

1. More recycling of materials from households and the service sector  
Economic details: In order to support work by the municipalities on increasing recycling, a number of initiatives will be implemented such as information and guidance, with examples of municipal experience and solutions. It will also be possible to apply

for subsidies for technological development, for example of separation facilities and for information about separation and recycling.

2. More recycling of materials from waste electronic equipment and shredder waste
3. From waste incineration to biogasification and recycling
4. Better exploitation of important nutrients such as phosphorus
5. Improved quality in recycling construction and demolition waste
6. Green conversion – new commercial opportunities

The Government places priority on local room to manoeuvre to find the right solutions to reach the goal of more recycling of household waste. Therefore the Strategy contains no new requirements for individual municipalities. It will still be up to the individual municipality to set the level of service and organization of waste management. Some municipalities will find it attractive to reorganize waste management within a short time-frame, while others will benefit more with a longer phase-in period.

The goal to double recycling of household waste requires more waste separation in future. This could be source separation at households and at central separation facilities. These decisions will be made locally. At the same time it is important to organise efforts cost-effectively and appropriately in a societal context.

(The Danish Government (2013): Denmark without Waste. Recycle more – incinerate less)

In 2014, the Danish EPA published the fifth plan (“waste resource management plan”) for 2013-18 which, together with the municipal waste plan, constitutes the Danish waste plan.

In 2015, the former Government published a strategy 6 for waste prevention.

(RECO Baltic 21 Teach (2012): National Waste Management Review. Sweden. Germany. Denmark. Finland)

### **Waste prevention and reuse programs**

Denmark is one of the highest per capita users of resources and generators of municipal waste in the world: waste that could have been prevented to benefit the environment, the climate and the economy.

In 2013, the Government launched its resources strategy entitled Denmark without Waste, which focused on ensuring a greater extent of recycling. Recycling the resources can take us a long way, but we also need to explore other paths if we are to prevent

waste. There is much to be saved from preventing waste from being generated in the first place. Therefore, this Waste Prevention Strategy deals with how we can produce and consume using fewer resources.

This Strategy has two cross-cutting topics, Transition in Danish businesses and Green consumption, and five action areas: Less food waste, Construction, Clothing and textiles, Electrical and electronic equipment, and Packaging.

(The Danish Government (2015): Denmark without Waste II. A Waste Prevention Strategy)

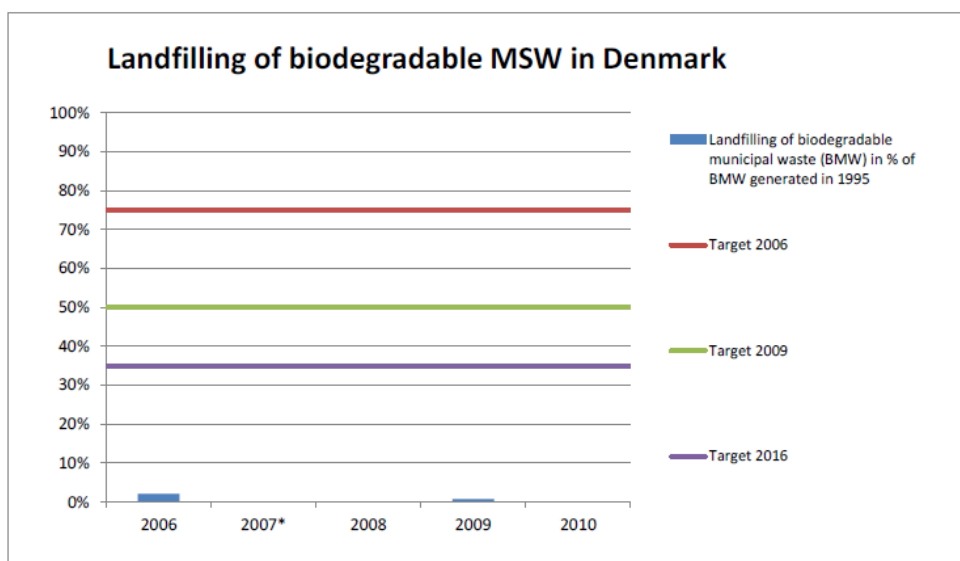
### Landfill bans, recycling targets

The major initiatives to improve MSW management in Denmark were taken before 2001. The landfill tax and incineration tax introduced in 1987 and the total ban on the landfilling of combustible waste (decided in 1994 and coming into effect on 1 January 1997) have been the main drivers for treatment of municipal waste in Denmark (Fischer et al., 2012). In addition, the establishment of separate collection schemes for paper, glass packaging, and garden waste has contributed significantly to the increased level of recycling. (Kjær, B. (2013): Municipal waste management in Denmark)

tool	target ▶	consumers	businesses	municipalities
legislative			<ul style="list-style-type: none"> <li>• Ban on landfilling of waste suitable for incineration (01/1997)</li> <li>• All waste incineration facilities have to be designed for energy recovery</li> <li>• Mandatory separation of construction and demolition waste with a view to recycling (1997)</li> </ul>	
			<ul style="list-style-type: none"> <li>• Mandatory separation of paper, cardboard, carton, steel drums, and plastic transport packaging for recycling (to be extended to PVC, impregnated wood, and waste electrical and electronic equipment)</li> <li>• Mandatory separation of organic food waste for catering services</li> <li>• Take-back scheme for discarded tyres (1995) with a 80% take-back rate target</li> <li>• Collection agreement (Returbat) for discarded lead accumulators (subsidies paid for collection)</li> </ul>	<ul style="list-style-type: none"> <li>• Mandatory separate collection of certain materials (paper and card, glass and hazardous waste)</li> <li>• Agreement with municipal councils on CFC-containing refrigerators</li> </ul>

economic	<ul style="list-style-type: none"> <li>Waste tax (1/1987): differentiated so that it is most expensive to landfill waste, cheaper to incinerate it and tax exempt to recycle it (hazardous waste and contaminated soil exempted)</li> </ul>	<ul style="list-style-type: none"> <li>Subsidies for projects aimed at solving waste problems by, for example, developing new forms of treatment (eg anaerobic digestion of organic domestic waste)</li> </ul>
	<ul style="list-style-type: none"> <li>Deposit-refund system for beer and carbonated soft drinks containers</li> <li>Variable charging for household waste in some municipalities</li> <li>Green taxes on containers (beverage and others), paper/plastic bags, packaging, disposable tableware, nickel-cadmium batteries,</li> <li>Environmental fee on tyres and Ni-Cad batteries for financing of collection and recycling</li> </ul>	<ul style="list-style-type: none"> <li>State subsidy schemes for projects on cleaner technology aimed at a reduction of environmental impacts from products over whole life cycle</li> </ul>
agreements		<ul style="list-style-type: none"> <li>Voluntary agreement on recycling of transport packaging (1994)</li> </ul>

figure 30: Overview of policy packages; Denmark (Green Alliance (2002): Creative policy packages for waste - lessons for the UK. Denmark)



Ban of landfilling of biodegradable MSW in Denmark Source: EC, 2012  
\* Data missing

figure 31: Landfilling of biodegradable MSW in Denmark (% of BMW generated in 1995)



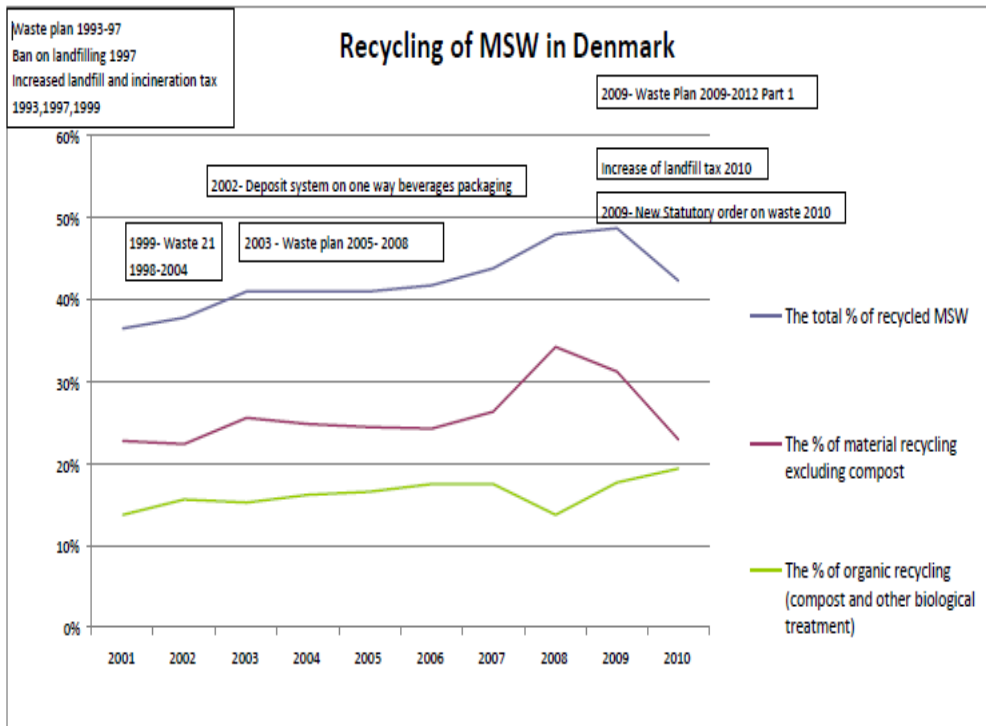


figure 32: Recycling of MSW in Denmark and important policy initiatives

The fourth national Danish Waste Plan 2009-2012 did not focus on new initiatives for recycling of municipal waste except a target for collection of batteries. (Kjær, B. (2013): Municipal waste management in Denmark)

- **Taxes for waste landfilling**

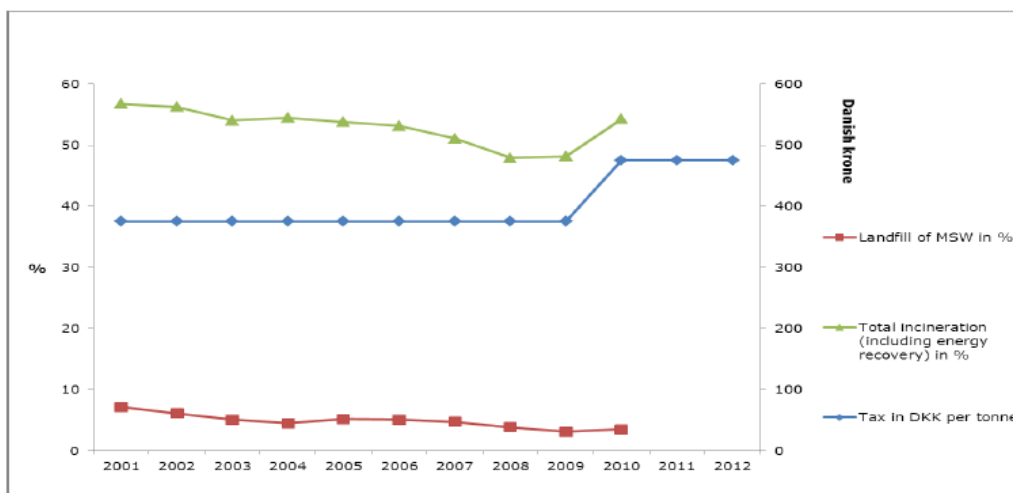
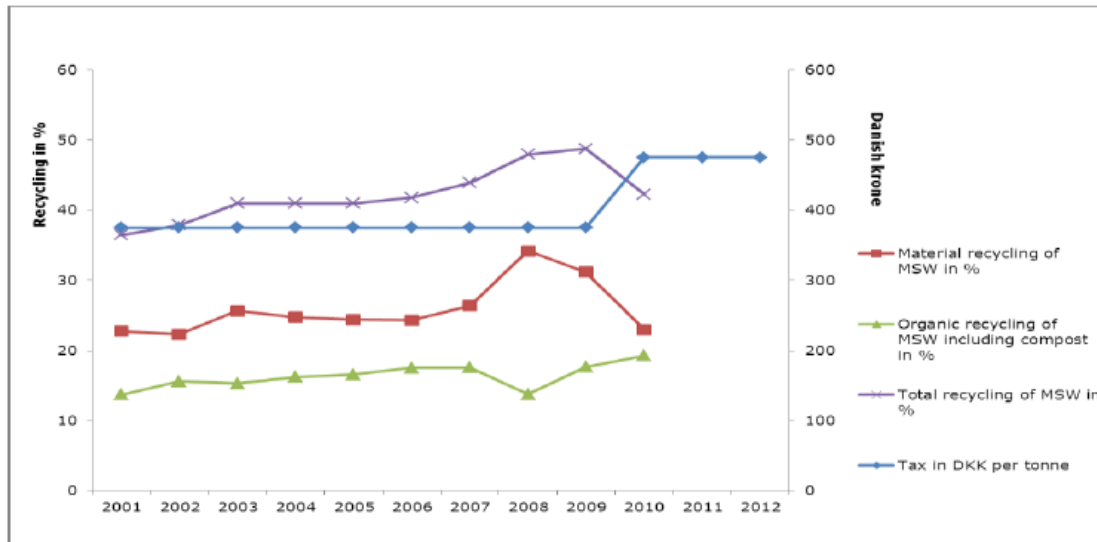


figure 33: Development of landfilling and incineration of MSW and landfill tax in Denmark



Source: ETC/SCP, 2012 and Eurostat, 2012

figure 34: Development of MSW recycling and landfill tax in Denmark

The Danish Landfill tax was introduced on the 1st January 1987 along with the introduction of a tax on incineration. The aim was to create an incentive to help reduce the amount of waste going to landfills and incineration plants and so promote recycling.

#### Who pays and how much

Originally the landfill tax only included landfills receiving waste from municipal collection schemes, but already in 1989 coverage was extended to all landfills with the exception of landfills for hazardous waste. In 1987 the tax was DKK 40 per ton of waste (~EUR 5.3). The tax was increased several times during the 1990s; to DKK 160 in 1993 (~EUR 21.3), DKK 335 in 1997 (~EUR 44.7), DKK 375 (~EUR 50) in 1999 and DKK 475 (~EUR 63.3) in 2010. The tax is levied on waste delivered to registered plants and a refund is granted for waste that is subsequently removed, e.g. for recycling. In that way the tax is only paid for the net amount received.

#### Exceptions

Until 2010, landfills for hazardous waste were exempt from the tax; however from 2012 those landfills will be required to pay DKK 160 per ton (~EUR 21.3), and the full tax (DKK 475) by 2015.

The following waste types are exempt from paying the tax:

- 1) Clean soil which is used for the daily and final covering of a landfill site;
- 2) Compost used for the final covering of a landfill site;
- 3) Ashes or slag stemming from the separate incineration of meat and bone meal

#### *Who monitors and collects*

The landfill owner or operator has to pay the landfill tax of every ton of waste delivered to the landfill and the tax will therefore be charged on the waste producers or waste collectors, who deliver waste to the landfill. The tax is paid as an addition to the price for waste deposition to the landfill. Every quarter of the year the landfill owner pays the tax to the regional customs and tax offices in Denmark. There are 6 regional offices in Denmark.

#### *Leakage issues*

Export of waste for landfilling requires, according to the EU Waste Shipment Regulation, an approval from the authorities. This implies that the authorities can say no to any transboundary shipment for landfilling. It seems that the landfill tax does not have any substantial effects on transboundary waste shipments, whereas the incineration tax has had some influence, because transboundary shipments for recovery cannot be rejected as easily as shipments for landfilling.

#### *Revenues generated, and what happens to them*

The revenue was EUR 69 million in 1993, EUR 41 million in 2000, EUR 18 million in 2009 and EUR 12 million in 2010. The revenue has firstly seen a decrease because less and less waste is landfilled.

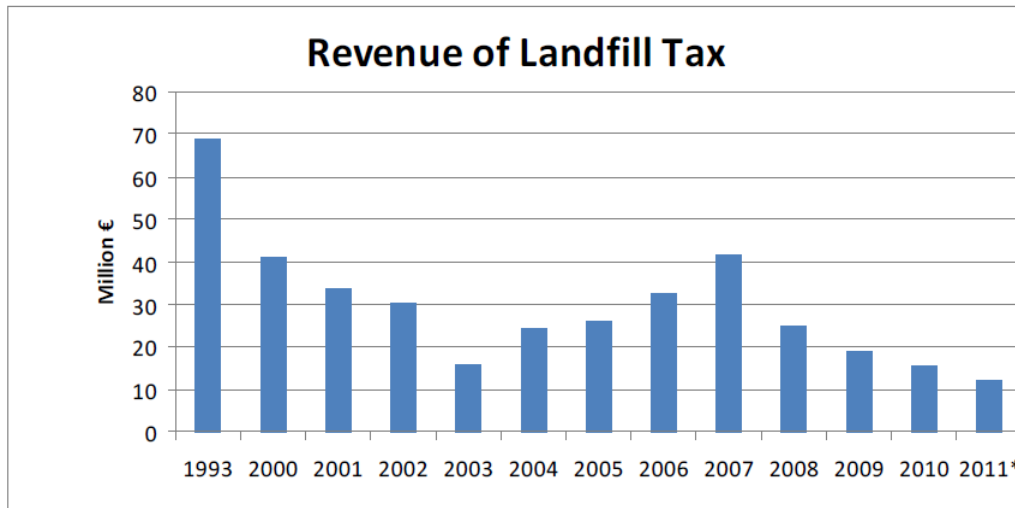


figure 35: Development in the landfill tax revenue in million Euro 1992- 2011

Note: \* Estimate made by the Danish Ministry of Tax in August 2011

The revenue of the tax is included in the ordinary state budget. The revenue is in that way spent on public expenses such as health, education, police etc. Originally when the tax was introduced, a larger part of the revenue was spent on supporting recycling and cleaner technology projects. (Fischer, Ch. Et al. (2012): Overview of the use landfill taxes in Europe)

### Pay-as-you-throw-system (PAYT)

Currently a number of fee-differentiated collection schemes exist for household waste in Denmark, such as weight-based and volume-based charging for collection, and schemes based on home composting.

Approximately 20 Danish municipalities have weight-based schemes for domestic waste from households, smaller companies and institutions. Tinglev municipality started the first such scheme in 1991 and during the 1990s, other municipalities followed. The level of service differs amongst the municipalities that have introduced weight-based schemes. Whilst some of the municipalities only collect domestic household refuse, others have a dual collection system where organic waste and residual waste are each collected separately. The municipalities also collect the recyclable fractions (like paper, cardboard and glass).

All the municipalities that have introduced a weight-based collection scheme are small or medium-sized, rural municipalities with few multi-storey buildings. Bogense municipality is used as an example of a weight-based collection scheme in Denmark. (Hogg, D. et al. (n.y.): Financing and Incentive Schemes for Municipal Waste Management . Case Studies)

### **Extended Producer Responsibility (EPR)**

Existing EPR schemes in Denmark in 2013:

Batteries

WEEE

Packaging (Product fee legislation / Governmental fund)

ELV

Tyres

Graphik, Paper

Types of producers' responsibilities:

Financial Responsibility with partial or full organisational responsibility

There seems to be a consensus on the fact that EPR systems should cover the collection, sorting and treatment costs of separately collected waste management minus the revenues from recovered material sales (thus the full net cost). (European Commission (2014): Development of Guidance on Extended Producer Responsibility)

### **Assessment of efficiency of existing and need of additional instruments**

#### **Recommended successful strategies and best practices**

##### **tax on landfill and incineration**

The most important means has been a waste tax on landfill and incineration, which has been in place since 1987. Initially, the tax was the same for landfill and incineration –

40DKK per tonne. It has been increased every year and has now reached 375DKK (£50) for landfill, 330DKK (£44) for incineration.

Being weight-based, the landfill tax has had a dramatic effect on building and construction waste. Soon after its introduction more than 80 per cent was being recycled. It had less dramatic effects on other industrial waste and little effect on household waste. Municipalities did not pass on the increased costs of disposal to householders in ways that would stimulate recycling, although some have now started to introduce pay-as-you-throw schemes to put a higher price on waste that is not recycled.

#### **mandatory separation of wastes**

Municipalities are required to provide separate collection of paper, glass, and hazardous waste from households. If paper collection targets are not met by 'bring systems', new regulations require doorstep collection to be introduced – although these powers have yet to be used. Trade and services (including larger scale industry) have to separate paper, cardboard, and plastic transport packaging. Yet in Copenhagen, for example, separate collection of paper from offices is still not mandatory. There is, however, mandatory separation for specific waste streams from industry, steel drums, plastics, PVC, impregnated wood.

#### **landfill ban and separation of combustible waste**

There is a ban on the landfill of waste suitable for incineration, implemented in 1997, so all authorities have to require separation of combustible and non-combustible waste. The effect of this has been a decrease in the amount of waste going to landfill.

#### **reuse and deposit-return systems**

Recycling is still the main focus of the waste strategy but reuse of beer and soft drink bottles – which Denmark regard as waste prevention – still has a high priority. Denmark estimate that reuse and deposit-return systems have resulted in 375,000 tonnes less waste. The present Danish government lifted the ban on the use of aluminium drinks cans and a deposit return system has been introduced instead.

### **taking control**

A crucial factor is taking control. The Environment Ministry took control and directed waste streams towards the right kind of treatment, for instance the various waste fractions that are now declared unsuitable for incineration, like PVC waste. The state-level policy of control is mirrored at local level.

### **local authorities' planning and management responsibilities**

Alongside the disposal taxes and bans there is a comprehensive waste management planning system which requires a local waste plan to be produced every fourth year, for the short term (four years) and for the longer term (12 years). The local waste management plans include schemes for recycling of waste, the collection system for household waste, as well as capacity planning for landfill and incineration. A key part of being able to implement these plans is the fact that municipalities are responsible for all the waste generated within their boundaries, including industrial wastes. Companies get an environmental license from the municipality and, as part of this must list the different kinds of waste generated. At the same time, all landfills and many incinerators are owned by local authorities, or by 34 inter-municipal regional waste utilities formed by groups of local authorities. Municipalities can thus plan capacity and invest in incineration plants, knowing what wastes are available to direct to them.

### **Information**

Information from the national level on environmental issues to the public has been an important factor in involving and motivating people for development of new waste management solutions. Information to the public on the benefits and results of the recycling system in which they participate is an important factor in order to keep up the motivation.

### **what are some of the issues for the future?**

#### **taxes not high enough to stimulate waste reduction**

There was also a general view that the taxes on disposal were not high enough to stimulate waste reduction. No company wants to produce products with a longer lifetime. What has produced results is the cleaner technology projects, which have led to a certain amount of waste minimisation.

### **possible expansion of incineration**

If both reduction and further recycling are difficult, this points to a possible expansion of incineration. The Danish government is considering how to ensure a more efficient waste sector by, for example, liberalising the incineration market.

### **improving the quality of waste**

Danish waste policy as focussing less on the amounts of waste and more on quality of waste streams, for instance less hazardous flue gas treatment residues, usable slags, getting heavy metals out of incinerator ash.

### **8.2.4 Waste management system financing**

The legal foundation of charging waste collection fees are especially levied in section 48 of the Danish Environmental Protection Act. It is a precondition of charging fees that the comprised waste system(s) and user groups is/are described thoroughly in the municipal regulations. The fixing of the waste fees is limited to the be-in-equilibrium principle meaning that the financial means received from user payment of waste handling may neither be more nor less than the municipal costs of the system (over some years). Thus, the payment for collection and treatment shall correspond fairly to the costs with which the user or a group of users are straining the system in question. Different models of taxation are applied in Denmark from flat rate to combination of different factors like volume, weight, property, collection of hazardous material, large household items, distance to bin, etc. A typology of different design options can be summarized as follow:

- Fixed fees for waste disposal;
- Fee based on waste amount of the property;
- Fixed fee combined with fee based on waste amount;
- Differentiated fees (e.g. separate payments for covering extra costs due to lift use, unlocking of doors, long distance from the kerb, etc.)
- Separate charges for ad-hoc services for particular products categories (e.g. garden waste);



Many Danish municipalities charge the waste collection fee as a fixed annual fee per container/sack put at the disposal of the user. If it is possible to use various container sizes, the fee is graduated accordingly, but not necessarily linearly in proportion to the container volume. If emptying takes place several times a week, the fee is multiplied by the emptying frequency. Typically, the waste collection fee is an overall fee that, apart from the compulsory systems for environmentally hazardous waste, paper and glass packing, also covers large household items, recycling site and possible collection of garden waste which is, however, equally often an additional choice at a separate fee. It is also a common approach not differentiating the charge between different building types. Irrespective of the fact that both.

The municipal waste management is financed through a municipal fee that all property owners pay. The fee is set by the City Council and covers the costs of planning, customer service, billing, information, collection and treatment. The system of charge differs among municipalities, some charge by weight, others by size of bin or number of bags. Some reduce the fee if the household have home composting. The different parts of the tariff should be self-financing. The municipal waste cannot be funded by tax.

Waste management in producer responsibility is financed by a fee that is included in the price of the product. Deposit and return systems have been established for a number of packaging types. For example, packages for beer and carbonated soft drinks must be covered by a deposit and return system.

The part of the expenses that cannot be covered by earnings from sale of electricity and heat must be covered by a gate fee, as the waste-to-energy facilities must be non-profit, i.e. the lower the energy earnings, the higher the gate fee. Typically, the gate fee, i.e. the actual cost for the household/industry of having its waste incinerated, is in the order of DKK 200 (€ 27)/tonne excluding taxes. The Danish gate fees are the lowest in Europe where gate fees of more than DKK 1,500 (€ 200)/tonne may be found. In an international context the low gate fee in Denmark is attributable partly to the extensive energy recovery from waste and partly to the generally well-operated and efficient facilities in Denmark.

The Danish waste-to-energy facilities continuously work on optimising their operation with a view to further reducing the heat price and the gate fee. More specifically, the efficiency of the relatively capital intensive production facilities has a great impact on the financial situation of the facilities, as outages are very expensive due to the loss of

energy earnings in these periods. Preventive maintenance is therefore of decisive importance. Major savings on maintenance in one year may well result in a postponement of the problems to subsequent years or lead to unplanned outages. The Danish waste-to-energy facilities are characterized by having an extremely high availability, typically more than 90 per cent of the year.

The greatest proportion of the waste collection charge for a typical household is for the actual waste collection, schemes for bulky waste and recycling as well as taxes to the State. The Danish waste-to-energy facilities are so well operated that they can provide cheap district heating, electricity and treatment of waste from households in an environmentally friendly manner. The disposal of waste by incineration therefore only makes up a very limited part of the total waste management cost. A household typically produces 600 kg of waste annually, which is incinerated at a cost of DKK 200 (€ 27)/tonne. This is approximately the same as the price of the waste collection bag at roughly DKK 2.5 (€ 0.33)/week

#### 8.2.5 Public awareness, education and communication initiatives

Current research and development projects, supported by public funding. Their findings will be published as they progress and can be used as a base for further research or as inspiration for new projects.

30 different project, e.g. Plastic Zero, Zero, Clean Waste, From organic waste to biofuels, Transforms organic waste from the city and the countryside into energy and fertilizer products, Shredder waste: Low-tech exploitation of resources in Shredder waste via size distribution, Market maturation of environmentally friendly and cost effective packaging for the food industry.

Big quantity of different institution and universities (more than 20 – Cooperation between universities, agencies, research facilities and ministries. (Andersen, E. K., Mortensen, J. (n.y.): Denmark: We know Waste)

#### 8.2.6 Barriers and success factors for waste management performance

According to the Ministry of Environment there are weaknesses in the Danish waste management system. Some of the most significant problems are: inadequate competition within the sector, confusion of the municipalities' roles as an authority and as an

operator, difficulties for waste producers to gain exemption from municipal waste collection schemes, data reporting requirements, lack of transparency in waste fees, inexplicable differences in processing fees, and failure to implement new treatment technologies (plants) under market conditions.

Behaviour and acceptance of the people to the waste system is always a concern in waste management. Denmark is no different in that aspect. Denmark has a high amount of waste per capita and waste prevention is the strategy for sustainability.

A technological challenge is to develop the waste management sector so that it can treat new and complex waste streams. (Reco Baltic 21 Tech, 2012)

### *Recommended successful strategies and best practices*

The major initiatives to improve MSW management in Denmark were taken before 2001. The landfill tax and incineration tax introduced in 1987 and the total ban on the landfilling of combustible waste (decided in 1994 and coming into effect on 1 January 1997) have been the main drivers for treatment of municipal waste in Denmark (Fischer et al., 2012). In addition, the establishment of separate collection schemes for paper, glass packaging, and garden waste has contributed significantly to the increased level of recycling.

Minor initiatives have been taken to improve MSW management from 2001 to 2010. The second national Danish Waste Plan 1998-2004 (Waste 21) set a target of 60 % recycling of paper and cardboard waste from households. Municipalities were obliged to introduce separate containers at each household for paper waste if the municipalities were performing under a certain collection rate. The potential in tonnes is huge. However, the data for collected paper from households have been quite stable from 2000 to 2009 (Miljøstyrelsen, 2011). During the last decade the recycling centres for household waste run by the municipalities have been expanded and more waste types can be delivered at the recycling centres.

The third national Danish Waste Plan 2005-2008 implemented the targets in the EU Directive for packaging and packaging waste to be fulfilled in 2008. A few initiatives focused on municipal waste. The municipalities had to implement collection schemes for metal packaging and certain types of plastic packaging (Regeringen, 2003). The introduction of a deposit system for one way beverages packaging in 2002 increased the amount of plastic and metal packaging waste and the amount of recycling. However,

the potential in tonnes for these schemes are quite small and it is not expected to influence the total recycling of municipal waste. (EEA, 2013)

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## 9. Overview of waste management in Italy

### 9.1 Overall background

Currently there are no data available.

#### 9.1.1 Country profile

Currently there are no data available.

#### 9.1.2 Development of economic and environmental situation

Currently there are no data available.

### 9.2 Waste management situation in Italy

#### 9.2.1 Legal and institutional framework of waste management

The most important piece of Italian waste legislation was issued in 1997 (Legislative Decree 22/97). It shaped the national waste management system (defining the responsibilities of the actors involved), introduced targets about separate collection of municipal waste, established the National Packaging Consortium and provided for the progressive replacement of the old waste tax with a new waste tariff. The Decree was, then, abrogated by Legislative Decree 152/2006 which, however, included most of its provisions. (EEA, 2013)

The regions issue regulations in compliance with the national legislation and define the 'optimal areas for the management of waste' (ATOs) that are responsible for meeting the targets on landfilling BMW and separate collection of municipal waste. The ATOs are supposed to represent a geographical entity where waste management is.

Italy has not developed a national waste management plan, as the legislation requires that plans are developed at regional level. The regional authorities have the task to draft waste management plans in order to organise and integrate waste collection, treatment and disposal within the "Optimal Management Areas" (ATOs) [IT DMWGN 2014, p. 288].

A specific definition of Municipal Solid Waste (MSW) is not included in the Italian legislation. The Legislative Decree 152/2006 ("Environment Code") [IT DL152/2006] §184 establishes the procedures for the classification of waste based on its origin, dividing waste into municipal and special waste and, depending on its properties, into hazardous and non-hazardous waste. The same article also defines **Municipal Waste (MW)** as:

- household waste, including bulky waste, originating from premises and places used as residential areas;
- non-hazardous waste originating from premises and places used for purposes other than those referred to in a), similar to municipal waste in terms of quality and quantity;
- street sweepings;
- litter of any type or from any source found on public or private roads and land that is subject to public use or on the seashore or lakeshore and on river banks;
- organic waste from green spaces such as gardens, parks and cemeteries;
- waste from exhumations and other waste originating from cemetery activities other than those referred to in b), c) and e). (European Commission - Italy National Factsheet, 2015)

Legislative Decree 152/2006 [IT DL152/2006], provides specific targets for separate collection of MW to be reached within the ATOs: a) at least 35% in terms of weight of total MW generation by December 31, 2006; b) at least 45% in terms of weight of total MW generation by December 31, 2008; c) at least 65% in terms of weight of total MW generation by December 31, 2012. Furthermore, in attachment E of Legislative Decree 152/2006 [IT DL152/2006] specific recovery and recycling targets for packaging materials are set such as: a) at least 60% in terms of weight of packaging waste shall be recovered or shall be incinerated in waste incineration plants with energy recovery by December 31, 2008; b) at least 55% in terms of weight) to a maximum of 80% in terms of weight of packaging waste shall be recycled by December 31, 2008 (specifically 60% for glass and paper/cardboard comprised in packaging materials, 50% for materials, 26% for plastic and 35% for wood).

Although these rates have been achieved in certain areas (Regions like Veneto, ATOs, municipalities), the rate achieved at national level in terms of MW separate collection is much lower (42.3% by the end of 2013) [IT DMWGN 2014, p. 297]. Since there is no National Waste Management Plan, no homogenous criteria to reach the targets nor

specific measures to “promote high quality recycling” have been identified at national level. The choice of streams to be collected (the legislation requires the collection of at least before 2015 plastic, paper, metal, glass and wood) and the collection methods are at the discretion of the ATOs and municipalities. Thus, it is difficult to assess for which streams separate collection has been introduced, since this varies from region to region and from municipality to municipality [IT WFD 2013, p 6]. However, since a crediting scheme exists in Italy for packaging waste, every municipality provides separate collections, or at least kerbside (i.e. door-to-door) collection, for the main fractions constituting packaging (paper, cardboard, plastic, metal and glass). The crediting scheme is managed by CONAI (National Consortium for Packaging, established by the Legislative Decree 22/2007, embodied in the Legislative Decree 152/2006 as amended by Legislative Decree 205/2010) which collects the environmental contribution (unit fees per unit weight) from different packaging producers and through that budget credits Municipalities for the tonnage of different separately collected packaging waste. Many municipalities in Italy (particularly in northern Italy) already manage bio-waste separately. (European Commission - Italy National Factsheet, 2015)

Name	Reference	Year
Incineration	Legislative decree n. 133/05, transposition of directive 2000/76/EC	no i
Landfill	Legislative decree n. 36/03 of 13 January 2003, transposition of directive 1999/31/EC Ministerial Decree of 3 August 2005 (repealing ministerial decree of 13th march 2003) which establishes criteria and procedures for the acceptance of waste at landfills, according to decision 2003/33/EC )	no i
IPPC	Legislative decree n. 59 of 18th February 2005, transposition of IPPC directive 61/96/EC; Ministerial decree of 29th January 2007 which provides specific guidelines for waste treatment plants authorization under IPPC.	no i
Recycling and/or recovery of hazardous and non hazardous waste	Ministerial Decree 5th february 1998 (as modified by ministerial decree n. 186/2007) which has introduced specific conditions, measures and options for the recycling and recovery of some typologies of non hazardous waste (included certain typologies of non hazardous C&D waste). Ministerial Decree 161/2002 which has introduced specific conditions, measures and options for the recycling of some typologies of hazardous waste (e.g some not ferrous metallic waste from thermal processes, some slags from thermal treatment of aluminium, some hazardous sludges, etc.) Ministerial Decree of 8 May 2003, n. 203 in application of the Law 448/2001 (public bodies and companies with prevailing public capital are required to buy at least 30% of their annual demand with products and goods made of recycled material)	no i

figure 36: National legislation

### 9.2.2 Development of waste management situation and infrastructure

The figure above shows the development of MSW generation per capita in Italy from 2001 to 2010 (the data for 2010 is a Eurostat estimate). There has been a slight increase in MSW generation per capita from 2001 to 2006 (from 516 kg/inhabitant to 552 kg/inhabitant), followed by a slight decrease in the second half of the decade (531 kg/inhabitant in 2010).

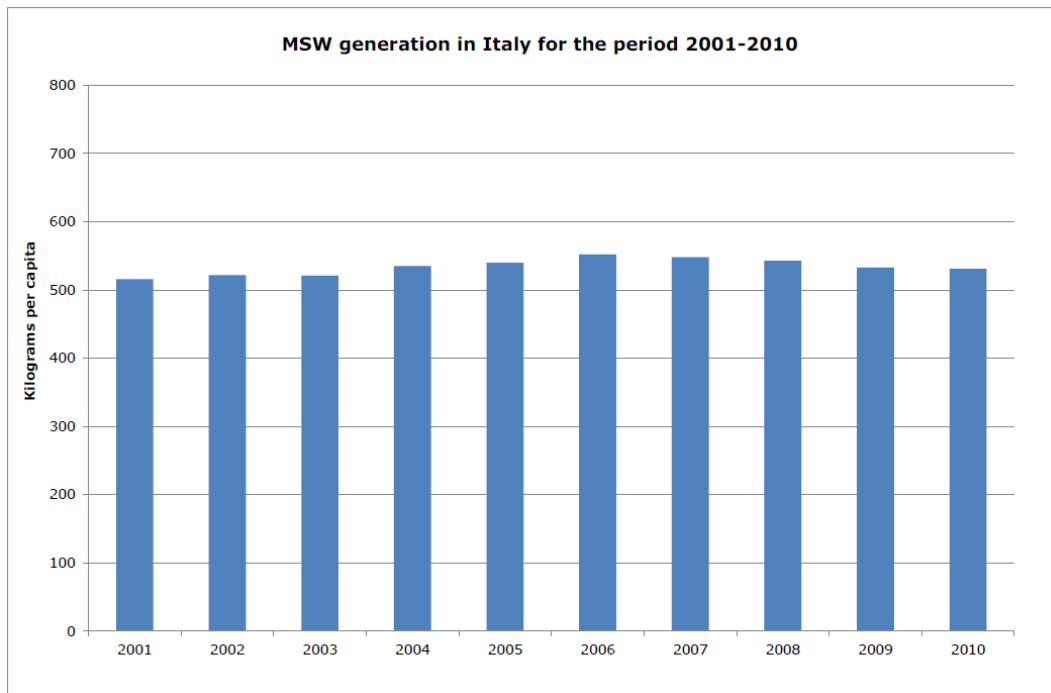


figure 37: MSW generation in Italy 2001- 2010 (Eurostat; 2012)

According to ISPRA (2012), which reports 32.5 million tonnes of MSW generation in 2010 and 532 kg/inhabitant, there are remarkable differences in per capita production across regions; in 2010, e.g., MSW generation ranged from 413 kg/inhabitant per year of Molise to 677 kg/inhabitant per year of Emilia Romagna. (EEA, 2013)

Statistics on packaging waste										
	Plastic packaging waste		Paper packaging waste		Metal packaging waste		Glass packaging waste		Total packaging waste	
	IT	EU	IT	EU	IT	EU	IT	EU	IT	EU
Total amount generated (in kt)	2,092	14,590	4,092	29,783	519	4,544	2,065	16,006	10,862	76,593
Total amount generated per capita (in kg)	34.8	29.2	68.0	59.5	8.6	9.1	34.3	32.0	180.5	153.1
Share of total packaging waste (in %)	19.3	19.0	37.7	38.9	4.8	5.9	19.0	20.9	100	100
Recycling rates (in %)	33.5	32.2	80.4	83.4	74.6	69.5	66.0	67.6	64.0	62.5
Further recovery rates including incineration with energy recovery (in %)	33.1	27.5	8.0	7.3	0.7	0	0	0	10.0	12.1
Disposal rates (in %)	33.4	40.3	11.6	9.3	24.7	30.1	34.0	32.4	26.0	25.4
Fulfilment of target of the Packaging Directive on recycling	yes	n/a	yes	n/a	yes	n/a	yes	n/a	yes	n/a

figure 38: Statics packaging waste generation in Italy (EEA- BiPro- Factsheet S. Italy 2013)



**Collection coverage and source-separate collection rates and infrastructure**

Waste collection basically covers 100% of the population. Cleansing of areas affected by littering and fly tipping is covered by Municipal services.

Waste management is established by law as a service of public interest, hence subject to strategic planning and to decisions taken by Municipalities (whom the primary responsibility for collection resides on), provided such decisions are aligned with strategies and policies defined at National and Regional level.

Many Municipalities tender out the waste collection service to private contractors. Largest towns traditionally have established their own public cleansing service (Municipal Waste Companies) which currently run the “in house” service upon a “Service Contract” whereby type of schemes and related costs are negotiated and approved. Such Municipal Waste Companies are currently undergoing a thorough transformation: often they are being grouped into larger Groups (gathering different Companies, e.g. A2A, IREN, HERA, etc.) with a corporate dimension, activities ranging from waste management to water supply to energy supply, and corporate policies driven mostly by financial drivers, rather than by public interest.

Collection of Packaging waste is covered by same schemes and contracts related to Municipal Waste.

Separate collection of packaging waste is common in North Italy, and fairly diffused in South Italy (above all for glass, whose collection is traditional in Italy). Separate collection of biowaste is undergoing a fast growth, and is showing to be the main driver to increase separate collection rates and improve waste management on the whole. In some Northern Regions (e.g. Veneto, Piedmont) separate collection of biowaste is widespread, also in large cities; pilot schemes are well established and consistently developed also in Southern Regions, above all in Campania (including large cities as Salerno and pilot neighbourhoods in Naples) but also in many Municipalities in Lazio, Puglia and Sicily.

Main problems are currently related to the need to change operational paradigms of waste collection in those many Municipalities where large investments have been made in the past on bring schemes (collection by means of road containers and side-loading packer trucks); as a matter of fact, the need to have the system shifting towards

kerbside collection (based on smaller receptacles and, for most materials, on non-compacting open lorries) requires a thorough revision of the waste collection infrastructure.

Packaging waste in Italy is mostly managed through the CONAI system, and this includes both Municipal Packaging Waste and Special (i.e. Industrial, commercial) Packaging Waste. CONAI, the National Packaging Consortium established by law, collects from producers the “environmental contributions” i.e. the unit fees per unit weight of different packaging materials.

The budget thereby defined, is then used to credit Municipalities for tonnages of separately collected packaging waste, with unit contributions varying for different packaging materials and quality of collected materials.

Alternatively, waste owners and producers may establish contractual agreements with private contractors, other than CONAI.

Although separate collection schemes may be varied according to different operational patterns (e.g. monomaterial vs. multimaterial, kerbside vs. road containers, etc.) the need for high-quality is driving the system towards:

1. Kerbside collection and
2. Monomaterial collection (with the possible exception of combined collection of plastics and cans, which may be easily separated afterwards) (EEA BiPro – National Factsheet S. Italy – 2013)

When comparing the actual development in separate collection with the targets, it appears that the targets were set according to the capacities of the northern regions rather than for the whole country. This is particularly the case for the second set of targets from 2006. Even though Italy had not yet met its 2003 target of 35 % separate collection, policy-makers decided to set more ambitious targets for 2007 that only the northern regions could realistically achieve. In general, kerbside or door-to-door separate collection provided the best results both in terms of amounts collected and the quality of the collected streams. (EEA – Diverting waste from landfill -2009)

### **Relevance of “informal” waste collection**

The informal sector isn't much developed and therefore doesn't play a dominant role. Many Charities and not-for-profit Associations, though, provide waste collection or management services upon a specific contract with Municipalities; this normally refers to separate collection (on the whole or of specific items, as worn-out dresses and textiles) or to management of Municipal Recycling Centre, often including some repairing/refurbishing activities. (BiPro EEA – Country factsheet S. Italy - 2013).

However Italy is faced with a lot of problems, because of illegal dumping of waste ( -> Triangle of Death, Naples Waste crisis, Toxic Dumping, Waste Mafia etc.

### **Prevention and reuse rates and infrastructure**

According to the European waste hierarchy, the Italian Waste Framework Law identifies waste prevention and waste minimization as priorities in the waste management system.

Article 179 of Decree 152/2006 provides that activities of public bodies must be primarily directed to promote waste prevention and waste minimization, through different measures, such as:

- promotion of clean technology, in order to improve and pursue savings in the use of natural resources;
- production and putting on the market of products that help to limit as far as possible the amount and hazardousness of waste generated;
- promotion of techniques that avoid the presence of hazardous substances in the products, in order to improve waste recovery.

General waste prevention targets have not been set at national level, but the transposition of EU directives led to the identification of bans for specific waste streams (e.g. ELV, packaging waste, WEEE and RoHS).

Targets have been set for collection and/or recycling/recovery of different typologies of waste (municipal waste, biowaste, packaging waste, waste from ELV demolition, WEEE, etc.), also in accordance to EU directives.

For instance, targets concerning recycling and recovering of packaging waste, established by directive 94/62/EC as modified by directive 2004/12/EC, have been transposed by the Framework Waste Law. In Italy, there is traditionally a high level of recycling and recovery of certain materials, such as wood, paper and paperboard; therefore, Decree 152/2006 institutes higher targets for these materials, than those set by the Packaging Directive.

Some examples of waste prevention strategies in Italy:

- introduction of home composting of biowaste,
- introduction of charging systems which includes a quota of payment proportional to the quantity of waste produced by each citizen/activity
- promotion of give back, take back systems
- promotion of reusable secondary packaging and recycled materials

#### **Material recycling and composting rates and infrastructure**

Targets on recycling packaging waste were first introduced in 1997 and then updated in 2006 concurrent with the targets on separate collection. These packaging recycling targets are the same as those in the revised Packaging Directive, except for those relating to plastic and wood, which have higher values than the ones set in the directive.

The Italian legislation provides for targets of 26 % for plastic and 35 % for wood, rather than the 22.5 % and 15 % respectively stipulated in the directive.

The level of separate collection is increasing in all the Italian regions, but Italy as a whole, with 35 % of MSW separate collection in 2010, equal to 11.4 million tonnes, is still far from achieving the national separate collection targets, introduced by Legislative Decree 152/2006 (the 2008 target was 45 %). ( EEA - Diverting Waste from landfill – 2009)

The following shows the rate of separate collection of municipal waste (or MSW total recycling SC) in Italian Regions from 2006 to 2010 and the actual national separate collection targets, introduced by Legislative Decree 152/2006 (ISPRA 2012). The higher separate collection rates have been achieved by some regions of the north (Veneto, Trentino Alto Adige and Piemonte) in 2010; in the south, Sardinia is characterised by a

very positive performance, thanks to the spread of separate collection systems (including kerbside schemes) and a high level of organic recycling (23 % in 2010; Arpas, 2010).

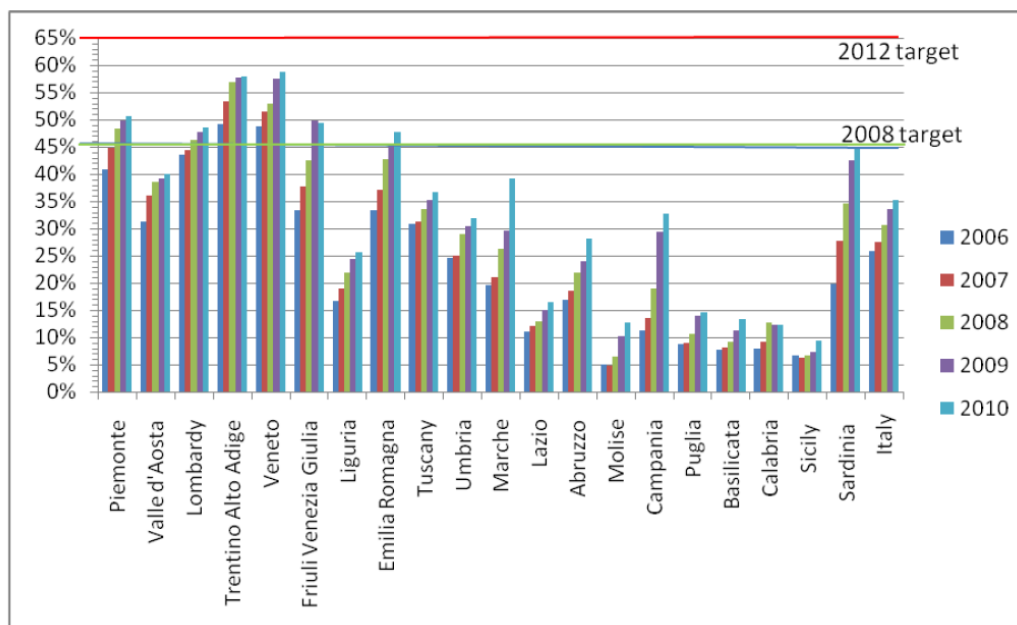


figure 39: Separate collection of MSW in Italian regions (2006- 2010) and separate national collection targets related to MSW generation (ISPRA; 2012)

### Treatment and energy recovery rates and infrastructure

The regions have chosen different strategies to divert municipal waste from landfills. Composting and incineration are more common in the northern regions due to the development and the adoption of integrated waste management strategies. In southern regions efforts have been channelled into building MBT plants and producing Re-use-Derived Fuel in order to overcome dependency on landfill.

The public has been very critical of the waste management sector, partly because of negative experiences with some old technologies used at certain waste management plants. In some regions investments in new incineration capacity are being planned with little opposition from local people whereas there is strong public opposition to new plants in other regions as illustrated by the case of Naples, where municipal waste mounted up in the streets in 2008. It is therefore very important to adopt strategies (particularly public information campaigns) to create constructive relationships with the public. Public acceptance may also increase following the adoption of national guidelines on best available techniques for waste incineration in 2007. (EEA Diverting waste from landfill 2009)

The tonnage of MSW combusted at waste-to-energy (WTE) facilities more than doubled from 1.6 million in 1996 to 3.5 million tonnes in 2004: this corresponds to an increase of the combusted MSW from 6.1 to 11.4 percent of the total MSW generated.

In general, the regions of the North of Italy are those that send to WTE facilities the largest quantity of MSW and RDF, in particular, the regions of Lombardia, Emilia-Romagna and Veneto. There are 45 WTE facilities and 3 incinerators in Italy: 29 are localized in the North (13 in Lombardia), 13 in the Center (8 in Toscana and 3 in Lazio) and 6 in the South. Thanks to the improvement of energy recovery technologies, the increase of the energy production has been greater than the increase of MSW tonnage combusted. In 2004, the plants with energy recovery managed 4.1 million tonnes of waste (3.5 million MSW plus medical waste and other special wastes), recovering 2.4 million MWh of electrical energy and 0.575 million MWh of thermal energy (Fig. 6). In 2004, the specific gross average production of electrical energy was 587 kWh per tonne of processed waste and of thermal energy 361 kWh per tonne. The corresponding BREF energy recovery was  $587 * 2.4 + 361 = 1770$  kWh per tonne (for the definition of BREF and the explanation of this conversion, refer to box at page 6) ( Rigamonti - 2006)

#### **Landfilling rates and technical compliance of disposal infrastructure**

Italy has traditionally landfilled most of its MSW, even if the landfill rates have constantly decreased between 2001 and 2010 (Eurostat, 2012), a reduction from 67 % to 48 % related to MSW generated (and from 19.7 to 15.4 million tonnes in absolute terms). However, also in this regard, there are substantial differences among regions. In 2010, e.g., Lombardy landfilled 8 % of its generated municipal waste and separate collection represented about 48.5 % of the total produced amount, while Sicily landfilled 93 % of its generated municipal waste (ISPRA, 2012). In general, it can be underlined that regions that are able to couple high separate collection rates with an adequate capacity for MSW processing under different waste treatment options and a market for recycled materials usually show lower landfill levels. (EEA, 2013)

Although Italy, which landfilled 82 % of its BMW in 1995, could have got a 4-year derogation period from the above-mentioned targets, it decided not to request a derogation. Moreover, instead of transposing the percentage-based targets set out in the Landfill Directive, Italy adopted targets based on the quantity (kilograms) of BMW produced per capita, which shall be reached at ATO level (Optimal Management Areas) or

provincial level (if the ATO is not yet delimited). That decision was based on two core reasons: the lack of reliable data on the quantity of biodegradable municipal waste landfilled in 1995 and the need to implement improved monitoring at the local level (EEA, 2009).

Targets have been defined for 2008, 2011 and 2018, since Italy transposed the Landfill Directive into national law in January 2003, i.e. 18 months after the deadline. As such the targets follow the intervals of the Directive with a delay of two years.

According to ISPRA (2012), in 2010, the 2008 national target had been met by 10 out of 20 Regions (Piemonte, Lombardy, Veneto, Friuli Venezia Giulia, Trentino Alto Adige, Emilia Romagna, Tuscany, Campania, Calabria, and Sardinia) and the 2011 target by 5 Regions (Lombardy, Veneto, Friuli Venezia Giulia, Trentino Alto Adige, and Emilia Romagna).

Most of Italy's regions are still far from achieving the 2008 target on diverting biodegradable waste from landfill, particularly in southern and central Italy. Six of the twenty regions have met the 2008 target, and the Lombardy region has already reached the 2018 target and landfills less than 81 kilograms per capita. As about half of the population lives in northern Italy (producing half of the waste generated), the 2008 target has almost been achieved at national level. (EEA – Diverting waste from landfill – 2009)

In Italy the landfill tax was introduced in 1996, based on Law 549/1995. The Law, which defines the upper and the lower level of the tax, is applied at a regional level. The tax is directly paid to the regions by landfill operators.

The heterogeneity in the tax levels applied by regions is quite high, ranging, as an average between 1998 and 2008, from EUR 5.2 per tonne in Campania to EUR 25.8 per tonne in Piemonte (ETC/SCP, 2012).

The average landfill tax for all the regions increased from EUR 14.24 per tonne in 2001 to EUR 18.84 per tonne in 2012 (Figures 2.5b and 2.6b). The number of regions applying the higher tax level (between EUR 20-30 per tonne) from 2008 to 2012 passed from 4 to 10, while, in the same period, the number of regions applying the lower tax level (between EUR 0-10 per tonne) decreased from 2 to 0 (Figures 2.5a and 2.6a). However, the actual average level of the tax is among the lowest compared with western European countries. (EEA, 2013)

The landfill tax has contributed to the diversion of waste from landfill. The effect, however, may have been limited because the tax, although it has slightly increased on

average since 2009, is still low compared to other European countries and may not provide sufficient incentives to choose an alternative to landfilling. The increase of the tax, foreseen by Decree 152/2006 in cases where ATO do not meet the targets on separate collection could foster waste management solutions other than landfilling-. (EEA, 2013)

### 9.2.3 Legal and economic instruments to support waste management hierarchy

#### **Waste management plans and targets**

Italy has not developed a national waste management plan, as the legislation provides that plans are developed at regional level. However, National Waste Framework Act gives general criteria for the implementation of regional plans. In particular these criteria are defined in article 199 of legislative decree 152/2006.

According to national criteria, regional plans on waste management must include several provisions, such as:

- measures to ensure a reduction in the quantity, volume and hazardousness of waste;
- identification of ATOs;
- number and types of municipal waste management plants that must be built in the region to ensure the proper management of non hazardous municipal waste within each ATO;
- the possibility of setting up funds to ensure a higher contribution to ATOs which ensure a better municipal waste management;
- provisions to avoid soil and water pollutions, arising from municipal and industrial waste landfilling;
- criteria to be followed by provinces in order to identify the areas not suitable for the location of plants;
- measures to prevent waste production and encourage reuse, recycling and recovery;
- measures to promote waste collection and management within the regional territory;

According to directive 1999/31/CE and decree 36/2003 of transposition, Italy has developed a national strategy regarding the reduction of biodegradable municipal waste going to landfills. This strategy identifies some instruments to be implemented in order to



achieve the targets. Each region has to establish its own plan for the reduction of biodegradable waste going to landfill, in order to ensure a suitable management of this kind of waste within the regional territory.

General waste prevention targets have not been set at national level, but the transposition of EU directives led to the identification of bans for specific waste streams (e.g. ELV, packaging waste, WEEE and RoHS).

Targets have been set for collection and/or recycling/recovery of different typologies of waste (municipal waste, biowaste, packaging waste, waste from ELV demolition, WEEE, etc.), also in accordance to EU directives.

For instance, targets concerning recycling and recovering of packaging waste, established by directive 94/62/EC as modified by directive 2004/12/EC, have been transposed by the Framework Waste Law. In Italy, there is traditionally a high level of recycling and recovery of certain materials, such as wood, paper and paperboard; therefore, Decree 152/2006 institutes higher targets for these materials, than those set by the Packaging Directive.

#### **Waste prevention and reuse programs**

The prevention programs set the following targets to be achieved by 2020, based on 2010 levels:

- a. 5 % reduction in the ratio: generated MSW/GDP; as a monitoring measure, the tendency of MSW/household consumption will be considered as well.
- b. 10 % reduction in the ratio: generated special hazardous waste/GDP.
- c. 5 % reduction in the ratio: generated special non-hazardous waste/GDP.

Special waste includes according to art. 184, paragraph 3 of Italian legislative decree 152/2006:

- a. waste from agriculture and agro-industry,
- b. waste resulting from demolition, construction, and from excavation activities;
- c. waste from industrial processes;
- d. manufacturing waste;
- e. waste from commercial activities;

- f. waste resulting from the activities of recovery and disposal of waste, sludge from treatment of water and
- g. waste arising from sanitary activities.

The programme stipulates that these targets could be changed into targets for single streams of waste types.

With reference to waste management, Italy is divided into several territorial partitions generally corresponding to the administrative precincts of the Provinces. Every territorial partition is composed of a certain number of Municipalities. In each territorial partition, the objective of selective waste collection is 65% to be reached by the end of 2012. The Municipalities whose bad performances don't allow to obtain this result are subject to a financial penalty consisting in an addition of 20% on the special tax on the price paid for the final disposal of waste.

The most important piece of Italian waste legislation was issued in 1997 (Legislative Decree 22/97). It shaped the national waste management system (defining the responsibilities of the actors involved), introduced targets about separate collection of municipal waste, established the National Packaging Consortium and provided for the progressive replacement of the old waste tax with a new waste tariff. The Decree was, then, abrogated by Legislative Decree 152/2006 which, however, included most of its provisions.

The generation of MSW topped in Italy in 2007, with 32.5 million tonnes and has since then decreased to 32 million tonnes in 2010 (Eurostat, 2012).

According to their origin, waste are classified as urban or special. Urban waste are those: a) originated by households; b) unhazardous originated by other economic operators (such as industry, artisans, commerce and trade, agriculture, tertiary) when they meet the qualitative and quantitative requisites fixed by the Municipality so that they must be similar in quality and quantity to urban ones; c) abandoned on the public soil; d) vegetable originated by gardens and green areas' care; e) from cemeteries.

Households and the other producers of urban waste are compelled to pay a rate which contributes to finance the management of urban waste. This rate is collected by the Municipality. There are two kinds of municipal charging: a) the tax; b) the tariff or PAYT calculated according to two different methods, the "presumptive" and the "precise" ones. The tax is regulated by the Decree n. 507 of 1993 but it is going to be gradually

substituted by the tariff. The tariff was introduced in the Italian fiscal system in 1997 for the first time.

The method of calculation is regulated by the Decree n. 158 of 1999. The tariff is not compulsory, but it can be enforced voluntarily by the Municipality. The deadline for the complete transition from the tax to the tariff has not been fixed yet. It has to be fixed by the Ministry of the Environment according to article 238 of the Decree n. 152 of 2006.

The tariff is composed of:

- a. a fix part which is determined according to the essential components of the public service of waste management especially referring to the investments and their amortization;
- b. a variable part which is determined according to (i) the quantity of waste given to the public service of management, (ii) the standard of the service offered by the Municipality, (iii) the size of the costs of waste management.

#### **Landfill bans, recycling targets**

Targets on recycling packaging waste were first introduced in 1997 and then updated in 2006 concurrent with the targets on separate collection. These packaging recycling targets are the same as those in the revised Packaging Directive, except for those relating to plastic and wood, which have higher values than the ones set in the directive. The Italian legislation provides for targets of 26 % for plastic and 35 % for wood, rather than the 22.5 % and 15 % respectively stipulated in the directive.

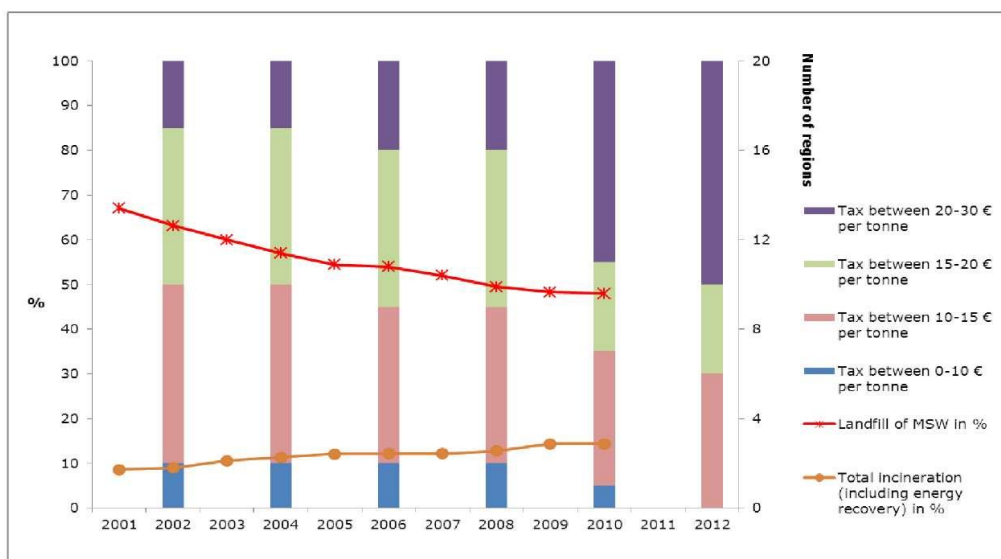
#### **Taxes for waste landfilling**

The tax is calculated multiplying the surface (in square meters) of the house or other places (i.e. offices, shops, restaurants, schools, museums and so on) by a rate expressed in €/m<sup>2</sup>.

This rate (€/m<sup>2</sup>) is generally the same for all households independently on the number of persons of which each family is composed, while it is differentiated for non-household users depending on the category of the economic activity carried out.

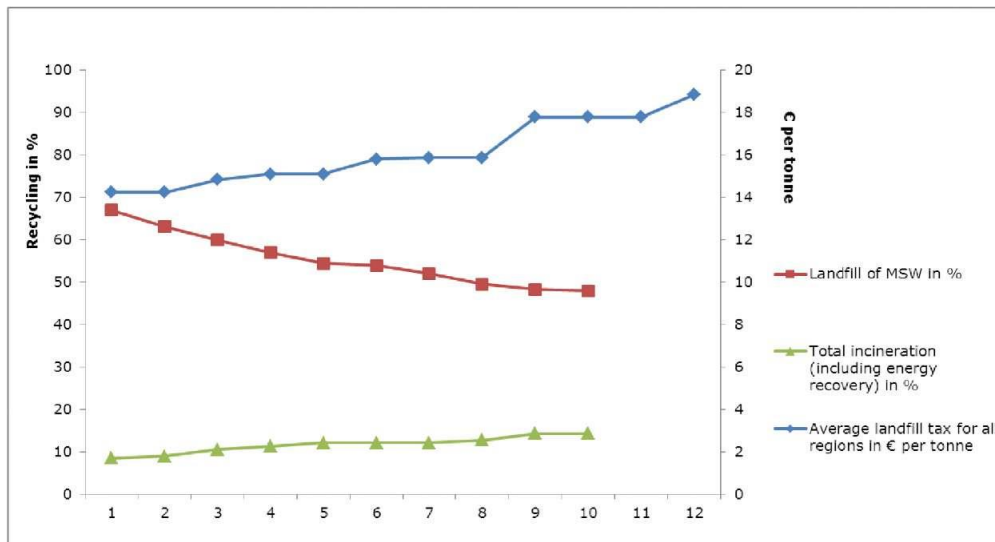
In both cases, there is no correspondence between the tax and the real quantity of waste produced and given to the public system of management no efficacy in preventing waste production.

In Italy the landfill tax was introduced in 1996, based on Law 549/1995. The Law, which defines the upper and the lower level of the tax, is applied at a regional level. The tax is directly paid to the regions by landfill operators. The heterogeneity in the tax levels applied by regions is quite high, ranging, as an average between 1998 and 2008, from EUR 5.2 per tonne in Campania to EUR 25.8 per tonne in Piemonte (ETC/SCP, 2012).



Source: Eurostat, 2012 and ETC/SCP 2012

figure 40: Development of landfilling and incineration of MSW and landfill tax in Italy; Distribution of taxes across the regions of Italy



Source: Eurostat, 2012 and ETC/SCP 2012

The increase of the landfill tax coupled with the stabilisation of the generation of municipal waste since 2007 and higher separate collection rates produced a strong reduction in the amount of disposable waste and a significant increase in total incineration (Figure 2.5a and 2.5b). It is also reflected in the positive trend of both material recycling (SC) and organic recycling (SC) (Figure 2.6a and 2.6b).

figure 41: Development of landfilling and incineration of MSW and landfill tax in Italy; Average level of tax of all Regions of Italy

The average landfill tax for all the regions increased from EUR 14.24 per tonne in 2001 to EUR 18.84 per tonne in 2012 (Figures 1.1 b and 1.2b). The number of regions applying the higher tax level (between EUR 20-30 per tonne) from 2008 to 2012 passed from 4 to 10, while, in the same period, the number of regions applying the lower tax level (between EUR 0-10 per tonne) decreased from 2 to 0 (Figures 2.5a and 2.6a). However, the actual average level of the tax is among the lowest compared with western European countries.

The landfill tax in Italy was introduced in 1996, based on Law 549/1995 and following amendments intended to reduce waste production and foster material and energy recovery. The Law defines the upper and the lower level of the tax (currently EUR 0.001-0.01/kg for inert waste and EUR 0.00517-0.02582/kg for hazardous and non-hazardous waste), which is applied at a regional level. According to the Law, the tax is based on the amount of solid waste landfilled.

The national framework law on waste was issued in 1997 (Legislative Decree 22/97), transposing three of the main EU directives on waste: the European Waste Framework Directive, the Directive on Hazardous Waste and the Directive on Packaging and Packaging Waste. The Decree introduced the following innovations:

- It defined the responsibilities among the actors of the national waste management system. In particular, regions hold the responsibility for drawing up waste management plans to promote waste reduction (with regard both to hazardousness and quantity), and municipalities within optimal management areas (ATO, which are generally represented by provinces) organise municipal waste collection and management;
- It set the following targets for separate collection of municipal waste to be achieved at ATO level (percentages are related to municipal waste generation);
  - 15 % by 1999;
  - 25 % by 2001;
  - 35 % by 2003;
- With regard to packaging waste, the Decree established the National Packaging Consortium (CONAI), with the aim to coordinate the activities of six material consortia for the recovery of aluminium, glass, paper, plastic, steel and wood. The Decree (and its following amendments) provided for more stringent packaging waste targets than the Community ones for plastic (26 % instead of 22.5 % stipulated in the Directive) and for wood (35 % instead of 15 % stipulated in the Directive) to be reached by 2008;

The Decree radically modified the tax for households on solid municipal waste generation (based on the floor area of the building), to be gradually replaced by the waste tariff. The tariff is not compulsory, but it can be enforced voluntarily by the municipality. The structure of the tariff includes: a quota to be determined in relation to the essential components of the cost of the service and a quota proportional to the quantity of waste produced by each subject, the standard of service offered by the municipality and the size of the costs of waste management.

Legislative Decree 36/2003 transposed the Landfill Directive. It required Regions to elaborate and approve a proper programme for reducing the amount of biodegradable

waste going to landfills, integrating the regional waste management plan, in order to achieve specific targets at ATO level (Optimal Management Areas) or provincial level (if the ATO is not yet delimited). The targets to be reached are the following:

- Before 27 March 2018: landfill of biodegradable municipal waste must be reduced to below 81 kg per inhabitant per year.
- At the regional level, the landfill tax level is strongly heterogeneous also among the most virtuous regions characterized by high recycling and low landfill rates. For example, in 2010, Veneto (59 % separate collection and 19 % landfilling; ISPRA 2012) applied a landfill tax of EUR 25.8 per tonne (ETC/SCP, 2012), while Lombardy (48 % separate collection and 8 % landfilling, ISPRA 2012) applied a landfill tax of EUR 10.5 per tonne (ETC/SCP, 2012).

#### **Biowaste diversion from landfills**

- The National Strategy for Biodegradable Waste defines targets for landfilling biodegradable municipal waste in kilograms per capita as well as targets for collecting municipal waste separately.
- Based on the Strategy, Italy's regions have developed programmes defining the instruments to use to divert waste from landfills. Separate collection, especially of biodegradable fractions of municipal waste but also of packaging waste, plays a major role. Whereas the programmes of the northern regions focus more on composting and incineration, the southern regions use more mechanical-biological treatment.
- Every 'optimal management area' (or province) has to meet a set of national targets for landfilling biodegradable municipal waste. These targets have been defined in kilograms per inhabitant in order to improve monitoring at the local level.
- Italy has steadily reduced landfilling of municipal waste so that about half was diverted in 2006. There is, however, a considerable difference between the performance of the northern regions and the southern and central regions (EEA Report, 2009: Diverting waste from landfill. Effectiveness of waste-management policies in the European Union)

### **Pay-as-you-throw-system (PAYT)**

Since 1994, the twenty administrative regions of Italy have delegated the responsibility of waste management to the office Ambito Territoriale Ottimale (Optimal Territorial Scope, ATO), which sets targets for the landfilling of biodegradable municipal solid waste and the separate collection of sorted waste. Districts/provinces are responsible for meeting the targets established by their ATO, but are free to implement a waste management system of their choosing. Frequently, this is realised through the creation of waste consortia, which determine waste management policy.

Households and other producers of urban waste are compelled to finance their municipal waste management system by paying either a tax or a tariff/PAYT which covers the costs of waste management and related administrative activities. Taxes are determined according to the surface area (in square meters) of the house or business establishment under consideration.

The tariff is composed of

- a. a fixed part (which funds essential components of the waste management infrastructure)
- b. a variable element which is determined by
  - the quantity of waste generated,
  - the standard of the service provided by the municipality,
  - the costs of waste management.

The variable component is determined by using either a presumptive calculative method or a precise method. The presumptive method is based on estimated quantities of waste set out for collection, while the precise rate is based on actual quantities of waste generated by a business or household.

### **Extended Producer Responsibility (EPR)**

CONAI is financed through the “CONAI Environmental Contribution” (CAC in Italian) applied to the packaging sold by the last Producer to the first User.



- when issuing an invoice, the Producer adds an amount in Euro equal to the weight in kilograms of the packaging sold multiplied by the value in Euro/kg set for that particular material;
- the Producer pays the resulting amount to CONAI, who will then transfer it to the competent Material Consortium after deducting a percentage for its own administration;
- The Material Consortia mainly use these funds to pay Municipalities the “collection fee”, as defined by the ANCI-CONAI Agreement for separate (or selective) collection.

The CONAI contribution is applied only to packaging used for the sale of goods on the Italian market, because this will produce waste within the Italian borders.

#### 9.2.4 Waste management system financing

Waste management has been the subject of significant debate in both national and international contexts. Although discussions have been both wide-ranging and searching, the relevance of the topic from an environmental, social, and financial perspective shows that development of further research is vital.

This work seeks to contribute to the debate regarding the eventual financial benefits of implementing environmental strategies, particularly for waste management firms. The analysis examines the Italian urban waste management firms (hereinafter, “WMFs”). The companies we studied are major players in the waste management system based on the “hierarchical” principle, regulated at the EU level (Directives 2006/12 and 2008/98) and establishing the following order of priority:

- a) prevention;
- b) reuse and preparation for reuse;
- c) recycle;
- d) recovery; and
- e) disposal.

Comuni dei Navigli have, since 1997, adopted a source separation scheme for biowaste, based on doorstep collection. Bags are used for the segregation of biowaste (on the one hand) and those for residual waste (on the other hand) were being distributed to householders free of charge. The PAYT system was first tested by Albairate Municipality (one of the municipalities belonging to the Navigli association) in June 1998, and PAYT was introduced more widely from 1 January 1999.

According to the principles of PAYT schemes, which have been mandated to be implemented within a few years throughout Italy, the sum to be paid for the cleansing service is composed of 2 parts, a fixed one and a variable one. In

Comuni dei Navigli, the fee structure is as follows:

- The fixed quota for householders is assessed allowing on the basis of the width of the house, the number of people in the household and the type of dwelling (e.g. flat, detached house with garden, terraced house, etc.). This is in conformity with what is requested by the national technical provisions issued as a consequence of the National Waste Management Act (Decree 22/97) which defines different categories and specific waste production indices; and
- The variable quota is assessed allowing for the number of bags used to deliver the residual waste to the cleansing service. Each householder has a magnetic card (Navigli cardí) whereby the household is identified through a numeric code. This is automatically linked to a personal set of bags and tags - with a bar code printed upon for the collection of residual waste.

The waste collector on each round collects the tags ñ which have to be tied by householders onto the bags ñ and then gives them to the Waste Taxation Office which is located at the Association of Municipalities. Together with the tags the waste collector also gives the Office the overall weight of the waste collected by the

vehicle throughout the collection round. The overall weight is then divided by the number of bags collected to assess an average weight of a single bag, and to develop a further level of control on the scheme.

In order to further verify the reliability of the estimates of the average weights of bags, some bags from different types of users (e.g. different dwelling conditions, commercial users) are randomly weighed. This ensures a more accurate estimation of the weight of waste delivered by different kinds of users.

The scheme allows a good weighting of the tariff according to the actual delivery by households of residual waste to be disposed of. It is interesting that Albairate reported a reduction in the system cost of 2€/inh/yr. This reflects the well-optimised system for collecting source-separated materials.

The computerised recording of data allows the managers to detect households and other users that don't use tags and bags. This therefore keeps the system under control and reduces the occurrence of lack of deliveries due to misbehaving (households with an overall delivery that seems to be particularly low can be checked).

The number of tags at each collection round, together with the overall weight of residual waste collected by the vehicle, enable the Association of Municipalities to tightly monitor and control the service supplied by contractors.

Source separation (and separation of foodwaste) is thus promoted indirectly, because households pay the variable quota in proportion to the amount of residual waste delivered, while the collection service for recyclables and biowaste is covered by the fixed part of the fee.

#### 9.2.5 Public awareness, education and communication initiatives

Awareness on environmental issues and sensitivity to waste-related problems is quite high, primarily due to the waste crisis that randomly have popped up across Italy, putting emphasis on waste management in the political and public debate. Also, some well known National Awards to best performing Municipalities, such as the "Comuni Ricicloni" award (granted to Municipalities with best separate collection rates by Legambiente, a major Env. NGO) has put performances of different separate collection systems in the public domain.

A “NIMBY” attitude towards waste management is quite diffused, due to the high density of population in the few areas suitable for siting (with a few exceptions, there is no such area that may be considered as “remote” enough).

Both, the awareness on waste issues and the problems with siting, have made the public highly prone to participating in separate collection schemes, above all when kerbside (door-to-door) schemes are considered; hence, whenever implemented, such schemes tend to deliver important results, in terms of quantity and quality of collected recyclables/compostable, irrespective of whether it is in the North or South, urban or rural areas.

### 9.2.6 Barriers and success factors for waste management performance

#### **Key barriers to change in waste management**

In comparison of UK one of Italy biggest waste related problems is that the responsibilities for waste are shifted upon different administration levels: national, regional, provincial and municipal. Each of these levels are responsible for the management of waste. Accordingly no national waste management plans exists and the regulation of waste management is much more difficult and inefficient.

In the following a short overview of the most relevant waste related:

- Obligation on treatment of waste to landfills not fully complied
- The potential of separate collection/recycling /composting not fully deployed
- Difficult siting of disposal sites (landfills, incinerators)
- Incomplete coverage of costs with regard to MSW management
- Lack of cross-consistency across different Regional WMPs
- Illegal delivery of special/hazardous waste into MSW
- (EEA BiPRO – Factsheet S. Italy – 2013)

#### **Recommended successful strategies and best practices**

Although Italy has reached in many district successful waste management performances, still various municipalities are faced with a lot of problems.

Hereinafter recommended strategies for improving the waste management situation in Italy are shortly summarized.

1. Provide waste management planning based on options in line with the waste hierarchy and by making use of the appropriate economic instrument in order to qualify for EU funding (2014-2020). Such EU funds should primarily support waste separate collection and recycling of waste with a view of meeting the recycling targets.
2. Progressively increase the existing landfill tax to levels necessary to effectively divert waste from landfills. Use revenues to support separate collection and alternative infrastructure.
3. Ensure full compliance with the legal obligation on pre-treatment of waste before disposal in order to make disposal less cost-competitive.
4. Facilitate the (re-)establishment of the ATO (Optimal Territorial Units) or similar entities for a coordinated planning of treatment and disposal sites so that municipalities can join/plan efforts and reduce waste management costs while providing legal certainty for private operators. Define capacity building programmes for local decision-makers in order to facilitate the exchange of good practices. (EEA BiPRO – Factsheet S. Italy – 2013)

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## 10.Development of Waste Management in post- soviet States in the last 30 years

### **10.1 Overall Background**

Currently there are no data available.

### **10.2 Legal and institutional framework of waste management**

Currently there are no data available.

### **10.3 Waste management situation**

Currently there are no data available.

### **10.4 Waste maagement system financing**

Currently there are no data available.

### **10.5 Barriers and success factors for waste management performance**

Currently there are no data available.

## 11. Overview of waste management in Belarus

### 11.1 Overall background

The Byelorussian Soviet Socialist Republic was declared on 1<sup>st</sup> of Jan, 1919 and named as Soviet Socialist Republic of Byelorussia. It left the RSFSR, and formed the union with the Lithuanian Soviet Republic (the SSR LitBel) on 27<sup>th</sup> of Feb, 1919. In the result of the Moscow agreement between RSFSR and Lithuania, the SSR LitBel was de facto abolished on 12<sup>th</sup> of July, 1920. LitBel de jure became extinct on 31<sup>st</sup> of July, 1920, when the Soviet Socialist Republic Byelorussia was re-established and renamed to the Byelorussian Soviet Socialist Republic. The BSSR (among other fourth soviet republics) signed the Treaty on the Creation of the USSR on 30<sup>th</sup> of December, 1922. The Declaration of State Sovereignty of the Belarusian Soviet Socialist Republic was adopted on 27<sup>th</sup> of July, 1990. BSSR was renamed to The Republic of Belarus on 19 September. Agreement Establishing the Commonwealth of Independent States was signed on 8<sup>th</sup> of December, 1991 together with Russia and Ukraine. Together with Russia and Ukraine Byelorussian SSR were a co-founder and member of the UN from 1945.

The economy of the BSSR. The energy sector was based on gas, oil (masut), peat, coal. Oil and peat production was carried out. The leader position in overall production had machine building and metal working production in particular automobile industry and tractor construction industry. Such industries as instrumental making, the radio engineering and radio electronic were well developed. The chemical and petrochemical industry had specialization in the production of mineral fertilizers, tires, plastic mixtures and synthetic materials, chemical fibers. The textile, knitting, leather and foot industries had high level of development also. In the 1970-80s the economy of BSSR as economy of the USSR in the whole began slowing down its rates. In 1982 average annual increase in the national income was 3,4 %. Huge money was invested in new projects which quite often were not finished. The technical level of BSSR became far behind the developed countries. The development of agriculture was contradictory. On the one hand the material and technical basis was increasing, on the other hand the rates of development of the agricultural industry was slowing down. The quantity of unprofitable industries was going up. Available data on demographic, social and economic situation in BSSR is shown in the Table 6.



Table 6: Social and economic profile of BSSR

Indicator	1980	1990
Population, ths per		10260
Life expectancy at birth		
Total		71,3
Men		66,4
Women		75,9
Rate of birth, per 1000	16,0	13,9
Rate of death, per 1000	9,9	10,7
Population growth rate	6,1	3,2
Infant mortality per 1000	16,3	11,9
Urbanization, %		66,4
Average family size, per		3,2
Average monthly incomes, rub	150,0	264,5
Labor force, ths per	4046	4236
GDP, mln \$		17370
GDP per capita, \$		1686
GDP structure:		
Industry		47
Agriculture		24
Services		29
Retail turnover, mln rub	9909	19145

### 11.1.1 Country profile

Table 7: General information about Belarus

Location	Eastern Europe, east of Poland
Area	total: 207600 km <sup>2</sup> land: 202900 km <sup>2</sup> water: 4700 km <sup>2</sup>
Land boundaries	total: 3599 km border countries: Latvia 161 km, Lithuania 640 km, Poland 375 km, Russia 1312 km, Ukraine 1111 km

Climate	cold winters, cool and moist summers; transitional between continental and maritime
Terrain	generally flat and contains much marshland
Elevation extremes	lowest point: Nyoman River 90 m, highest point: Dzyarzhynskaya Hara 346 m
Natural resources	timber, peat deposits, small quantities of oil and natural gas, granite, dolomitic limestone, marl, chalk, sand, gravel, clay
Land use	arable land: 26,63 % permanent crops: 0,59 % other: 72,78 % (2011)
Irrigated land	1150 km <sup>2</sup> (2003)
Total renewable water resources	58 km <sup>3</sup> (2011)
Freshwater withdrawal (domestic/industrial/agricultural)	total: 4,34 km <sup>3</sup> /yr (32%/65%/3%) per capita: 435,4 m <sup>3</sup> /yr (2009)
Environment current issues	soil pollution from pesticide use; southern part of the country contaminated with fallout from 1986 nuclear reactor accident at Chernobyl' in northern Ukraine

### 11.1.2 Development of economic and environmental situation

Table 8: Demographic and social profile of Belarus

Population	9608058 (July 2014)
Age structure	0-14 years: 15,4% (male 759285/female 717118) 15-24 years: 11,7% (male 575907/female 544170) 25-54 years: 45,5% (male 2141419/female 2227433) 55-64 years: 13,3% (male 562639/female 716216) 65 years and over: 14,2% (male 430225/female 933646) (2014)
Median age	total: 39,4 years male: 36,3 years female: 42,4 years (2014)
Life expectancy at birth	total population: 72,15 years male: 66,53 years female: 78,1 years (2014)
Population growth rate	-0,19% (2014)
Birth rate	10,86 births/1000 population (2014)
Death rate	13,51 deaths/1000 population (2014)
Infant mortality rate	total: 3,64 deaths/1000 live births male: 4,07 deaths/1000 live births female: 3,19 deaths/1000 live births (2014)
Net migration rate	0,78 migrant(s)/1000 population (2014)
Urbanization	urban population: 75% of total population (2011) rate of urbanization: 0,21% annual rate of change (2010-15 est.)
Mother's mean age at first birth	25,1 (2011)

Total fertility rate	1,47 children born/woman (2014)
Ethnic groups	Belarusian 83,7%, Russian 8,3%, Polish 3,1%, Ukrainian 1,7%, other 2,4%, unspecified 0,9% (2009)
Religions	Eastern Orthodox 80 %, other (including Roman Catholic, Protestant, Jewish, and Muslim) 20 % (1997)
Languages	Belarusian (official) 23,4 %, Russian (official) 70,2 %, other 3,1 % (includes small Polish- and Ukrainian-speaking minorities), unspecified 3,3% (2009)
Literacy	total population: 99,6 % male: 99,8 % female: 99,5 % (2009)
School life expectancy (primary to tertiary education)	total: 16 years
Education expenditures	5,1 % of GDP (2012)
Health expenditures	5,3 % of GDP (2011)
Physicians density	3,76 physicians/1000 population (2011)
Hospital bed density	11,1 beds/1000 population (2011)
Obesity - adult prevalence rate	24,3 % (2008)
Children under the age of 5 years underweight	1,3 % (2005)
Drinking water source	improved: urban: 99,8 % of population rural: 99 % of population total: 99,6 % of population
Sanitation facility access	improved: urban: 94 % of population rural: 95,3 % of population total: 94,3 % of population

### *Economic situation:*

As part of the former Soviet Union, Belarus had a relatively well-developed industrial base; it retained this industrial base - which is now outdated, energy inefficient, and dependent on subsidized Russian energy and preferential access to Russian markets - following the breakup of the USSR. The country also has a broad agricultural base which is inefficient and dependent on government subsidies. After an initial burst of capitalist reform from 1991-94, including privatization of state enterprises, creation of institutions of private property, and development of entrepreneurship, Belarus' economic development greatly slowed. About 80 % of all industry remains in state hands, and foreign investment has been hindered by a climate hostile to business. A few banks, which had been privatized after independence, were renationalized. State banks account for 75 % of the banking sector. Economic output, which had declined for several years following the collapse of the Soviet Union, revived in the mid-2000s thanks to the boom in oil prices. Belarus has only small reserves of crude oil, though it imports most of its crude

oil and natural gas from Russia at prices substantially below the world market. Belarus exported refined oil products at market prices produced from Russian crude oil purchased at a steep discount. In late 2006, Russia began a process of rolling back its subsidies on oil and gas to Belarus. Tensions over Russian energy reached a peak in 2010, when Russia stopped the export of all subsidized oil to Belarus save for domestic needs. In December 2010, Russia and Belarus reached a deal to restart the export of discounted oil to Belarus. Little new foreign investment has occurred in recent years. In 2011, a financial crisis began, triggered by government directed salary hikes unsupported by commensurate productivity increases. The crisis was compounded by an increased cost in Russian energy inputs and an overvalued Belarusian ruble, and eventually led to a near three-fold devaluation of the Belarusian ruble in 2011. In November 2011, Belarus agreed to sell to Russia its remaining shares in "Beltransgaz", the Belarusian natural gas pipeline operator, in exchange for reduced prices for Russian natural gas. Receiving more than half of a \$3 billion loan from the Russian-dominated Eurasian Economic Community (EurAsEC) Bail-out Fund, a \$1 billion loan from the Russian state-owned bank "Sberbank", and the \$2,5 billion sale of "Beltransgaz" to Russian state-owned "Gazprom" helped stabilize the situation in 2012; nevertheless, the Belarusian currency lost more than 60 % of its value, as the rate of inflation reached new highs in 2011 and 2012, before calming in 2013. As of January 2014, the final tranche of the EurAsEC loan has been delayed, but in December 2013 Russia announced a new loan for Belarus of up to \$2 billion for 2014. Notwithstanding foreign assistance, the Belarusian economy continues to struggle under the weight of high external debt servicing payments, a growing trade deficit, stagnant economic growth, and low foreign reserves. Some economic data is represented in the Table 9.

Table 9: Economic profile of Belarus

GDP (purchasing power parity)	\$150,4 billion (2013) \$147,3 billion (2012) \$145 billion (2011) note: data are in 2013 US dollars
GDP (official exchange rate)	\$69,24 billion (2013)
GDP - real growth rate	2,1 % (2013) 1,5 % (2012) 5,5 % (2011)
GDP - per capita (PPP)	\$16 100 (2013) \$15 700 (2012) \$15 400 (2011) note: data are in 2013 US dollars
Gross national saving	24,8% of GDP (2013)

	31,8% of GDP (2012) 29,2% of GDP (2011)
GDP - composition, by end use	household consumption: 46,3 % government consumption: 15,3 % investment in fixed capital: 30 % investment in inventories: 0,7 % exports of goods and services: 80,2 % imports of goods and services: -72,5 % (2013)
GDP - composition by sector	agriculture: 9,2 % industry: 46,2 % services: 44,7 % (2013)
Population below poverty line	27,1 % (2003)
Labor force	5 million (2009)
Labor force - by occupation	agriculture: 9 4 % industry: 45 9 % services: 44 7 % (2005)
Unemployment rate	1 % (2009) 1,6 % (2005) note: official registered unemployed; large number of underemployed workers
Unemployment, youth ages 15-24	total: 12,6 % male: 12,4 % female: 12,6 % (2009)
Household income or consumption by percentage share	lowest 10 %: 3,8% highest 10 %: 21,9% (2008)
Distribution of family income - Gini index	27,2 (2008) 21,7 (1998)
Budget	revenues: \$26,68 billion expenditures: \$26,79 billion (2013)
Taxes and other revenues	38,5 % of GDP (2013)
Budget surplus (+) or deficit (-)	-0,2 % of GDP (2013)
Public debt	31,5 % of GDP (2013) 31,5 % of GDP (2012)
Inflation rate (consumer prices)	19 % (2013) 59,1 % (2012)
Central bank discount rate	10,5 % (31 December 2010) 13,5 % (31 December 2009)
Commercial bank prime lending rate	10 % (31 December 2013) 19,49 % (31 December 2012)
Stock of narrow money	NA % (31 December 2013) \$4,018 billion (31 December 2012)
Stock of broad money	\$9,073 billion (31 December 2013) \$7,655 billion (31 December 2012)
Stock of domestic credit	\$22,68 billion (31 December 2013) \$19,82 billion (31 December 2012)
Agriculture - products	grain, potatoes, vegetables, sugar beets, flax; beef, milk

Industries - products	metal-cutting machine tools, tractors, trucks, earthmovers, motorcycles, televisions, synthetic fibers, fertilizer, textiles, radios, refrigerators
Industrial production growth rate	1 % (2013)
Current Account Balance	-\$4,245 billion (2013) -\$1,688 billion (2012)
Exports	\$42,06 billion (2013) \$45,57 billion (2012)
Exports - commodities	machinery and equipment, mineral products, chemicals, metals, textiles, foodstuffs
Exports - partners	Russia 35,4 %, Netherlands 16,4 %, Ukraine 12,1 %, Latvia 7,1 % (2012)
Imports	\$45,17 billion (2013) \$45,01 billion (2012)
Imports - commodities	mineral products, machinery and equipment, chemicals, foodstuffs, metals
Imports - partners	Russia 59,4 %, Germany 5,9 %, China 5,1 %, Ukraine 5 % (2012)
Reserves of foreign exchange and gold	\$4,513 billion (31 December 2013) \$5,809 billion (31 December 2012)
Debt - external	\$1,204 billion (31 December 2013) \$1,225 billion (31 December 2012)

*Environmental situation:*

Environmental footprint of Belarus is briefly represented in Table 10.

Table 10: environmental footprint of Belarus

Year	Carbon dioxide emissions (CO <sub>2</sub> ), kg CO <sub>2</sub> per \$1 GDP (UN-FCCC)	Carbon dioxide emissions (CO <sub>2</sub> ), metric tons of CO <sub>2</sub> per capita (UN-FCCC)	Carbon dioxide emissions (CO <sub>2</sub> ), thousand metric tons of CO <sub>2</sub> (UN-FCCC)	Consumption of all Ozone-Depleting Substances in ODP metric tons	Energy use (kg oil equivalent) per \$1,000 GDP	Terrestrial and marine areas protected to total territorial area, %	Terrestrial and marine areas protected, sq. km.
1990	1,56	10,1	103806,8	1554,3	684	6,55	13566
1991	1,48	9,5	97475,4	1451,2	674	6,65	13780
1992	1,52	8,7	90060,2	1161,9	622	6,66	13801
1993	1,41	7,5	77204,2	1161,5	574	6,82	14138

1994	1,33	6,3	64506,2	1007,3	552	6,84	14179
1995	1,33	5,6	57599,8	595,3	570	7,17	14850
1996	1,31	5,7	58553,8	599,8	568	7,22	14962
1997	1,2	5,9	59868	418,4	509	7,22	14962
1998	1,08	5,7	58064,8	278,9	460	7,22	14962
1999	0,99	5,5	55404,1	208,3	433	7,22	14962
2000	0,9	5,3	53319,3	16,8	418	7,22	14962
2001	0,85	5,2	52347	9,3	401	7,22	14962
2002	0,81	5,3	52528,8	2,7	389	7,22	14962
2003	0,76	5,3	52888,4	4,5	374	7,22	14962
2004	0,73	5,7	56258,5	3,1	347	7,22	14963
2005	0,68	5,8	56669,8	0,6	322	7,22	14964
2006	0,64	6,1	59128,5	1,3	310	7,22	14964
2007	0,58	6	58280	0,8	277	7,22	14964
2008	0,54	6,2	60365,4	0,4	250	7,22	14964

## 11.2 Waste management situation

### *11.2.1 Legal and institutional framework of waste management*

#### **Before 1990**

The law on land protection was adopted in the USSR in 1968. It was the first law on environmental protection in the country. Later other environmental laws were developed and approved. Soviet environmental legislation had focus on management of natural resources (land, water, forests and air). Only law on atmosphere protection included articles about control of emissions, pollutions and protection of environment. All other laws regulated environment protection in general words.

In general, there was not a special law on WM. The legislation in the sphere of WM had focus on SRM, their collection and utilization. The main point was establishment of economic instruments for utilization of SRM, especially metals. For example:

- ➔ Letter of Ministry of finances of the USSR from 30.06.1975 № 65 “On the order of payments to the budget for waste and scrap of ferrous and non-ferrous metals”;
- ➔ Letter of Ministry of finances of the USSR from 25.12.1975 № 119 “On the calculations of public specialized organizations "Vtorchermet" and "Vtortsvetmet" for waste and scrap of ferrous and non-ferrous metals, handed over schools and other institutions, consisting on a budget”;
- ➔ Resolution of the Council of Ministers from 12.10.1977 № 910 “About bonus payment to employees for collection, storage, delivery and shipment of scrap and waste of ferrous and nonferrous metals”.

In 1977 the first technical standard on development and design of landfills was established: Sanitary rules of design, construction and operation of landfills for non-utilized industrial waste (Appr. Ministry of Health of the USSR 22.08.1977 № 1746-77).

In the end of 1970s and beginning of 1980s the development and improving environmental legislation was continued. At the same time changes in environmental legislation did not have principle character. In that time economic interests were in the top priority, and environmental legislation did not have strong instruments for nature protection. Environmental legislation was inefficient. The enforcement was another weak point of environmental legislation. In regards to WM in the end of 1970s and beginning of 1980s the focus on collection and utilization of SRM was saved:

- ➔ Resolution of the Council of Ministers from 25.01.1980 № 65 “On measures to further improving the use of recycled materials in the national economy”;
- ➔ Resolution of the Central Committee of Communist Party of Soviet Union and Council of Ministers from 23.07.1981 № 715 “On measures for further improvement of the processing (delivery), and scrap recycling non-ferrous metal waste and increase the technical level of the secondary non-ferrous metallurgy enterprises”;



- ➔ Resolution of the Council of Ministers from 04.11.1982 № 965 “On the improvement of industrial use (business) of ferrous waste”;
- ➔ Resolution of the Central Committee of Communist Party of Soviet Union and Council of Ministers from 16.01.1985 № 57 “On the improvement of the use of non-ferrous metals in the economy, further development and improvement of the technical level of the secondary non-ferrous metal industry”;
- ➔ The sanitary rules on production and quality assessment of paper and cardboard produced with the use of recycled paper and are intended to pack dry food products (Appr. Ministry of Health of the USSR 20.05.1986 № 4105-86).

The sanitary standard on collection, storing, transportation and utilization of SRM was established in 1982: *Sanitary rules for the collection, storage, transport and primary processing of secondary raw materials* (Appr. Ministry of Health of the USSR 22.01.1982 № 2524-82).

In the beginning of 1980s the first regulations on management of hazardous waste were adopted:

- ➔ Limit amount of toxic compounds in industrial waste that makes the assignment of these wastes to the category of toxicity (Appr. Academy of Science of the USSR 27.12.1984, Ministry of Health of the USSR 18.12.1984 № 3170-84);
- ➔ Procedure for storage, transportation, disposal and dumping of toxic industrial waste (sanitary rules) (Appr. Ministry of Health of the USSR 29.12.1984 № 3183-84);
- ➔ Resolution of the Council of Ministers from 15.02.1980 № 143 “On measures for further improvement of the organization of the collection and use of oil wastes”;
- ➔ Limit amount of accumulation of toxic industrial waste at the territory of the enterprise (organization) (Appr. Chief State Sanitary Doctor of the USSR 01.02.1985 № 3209-85, Ministry of Water Resources of the USSR 21.02.1985 № 13-3-5/178, USSR Ministry of Geology 02.01.1985);
- ➔ Guidelines for the control of the organization of current and final demercurisation and evaluation of its effectiveness (Appr. Ministry of Health of the USSR 31.12.1987 № 4545-87);
- ➔ Sanitary rules on work with mercury, its compounds and mercury-filled devices (Appr. Chief State Sanitary Doctor of the USSR 04.04.1988 № 4607-88).

The first Cadaster of toxic waste was adopted in 1987: Temporary classifier of toxic industrial wastes and guidelines for the definition of the toxicity class of industrial waste (Appr. Ministry of Health of the USSR 13.05.1987 № 4286-87, State Committee of Science and technology of the USSR 05.05.1987).

In the 1980s the first documents on municipal waste and sanitary maintenance of urban areas were developed and enforced:

- ➔ The order of Health Ministry of the USSR from 20.07.1983 № 858 "On enforcement of the rules on sanitary protection of the territory of the USSR";
- ➔ Sanitary Regulations on maintenance of settlements. SanPiN 42-128-4690-88 (Appr. Ministry of Health of the USSR 05.08.1988 № 4690-88).

In the end of Soviet era the Government realized that environmental policy should be changed, the economic instruments for nature protection should be improved or established, and the main principle "the polluter pays" should be implemented. As a result the list of documents was approved:

- ➔ Resolution of the Supreme Council of the USSR from 03.07.1985 "On compliance with the requirements of legislation on nature protection and rational use of natural resources";
- ➔ Resolution of the Central Committee of Communist Party of Soviet Union and Council of Ministers from 07.01.1988 № 32 "About radical restructuring of the nature protection in the country";
- ➔ Resolution of the Supreme Council of the USSR from 27.11.1989 "On urgent measures of ecological rehabilitation of the country".

The [resolution № 32](#) "About radical restructuring of the nature protection in the country" stated (1) consolidation of state control of the management of natural resources and environmental protection through the organization of the USSR State Committee for Nature Protection; (2) the improvement of the economic mechanism ensured efficient

use and conservation of natural resources (primarily through payment for use and pollution of natural resources); (3) the solution on the development of the USSR Law on environment protection.

Before the USSR collapse the system of environmental legislation did not include the laws on WM, the regulations were insufficient due to underdevelopment of economic instruments and weak enforcement. At the same time the system of collection and utilization of SRM was strong and had well-developed legislation (laws, rules and technical standards).

The state policy in the recycling provided high increase of economical use of SRM. In the most cases the use of waste as SRM was increasing much faster, than the waste generation. Special [State Program](#) established increasing the use of recycled materials by more than twice from 1986 to 2000. According to the integrated program of the scientific and technological development of the USSR, by the 2000 the level of treatment of the main large-tonnage waste had to reach 100 % for some types of waste (ferrous and non-ferrous metal wastes, used petrochemical products, sulfur wastes, slag of ferrous and non-ferrous industry, lignin, waste paper, textile, polymer, leather and wood). The level of MSW treatment should be achieved 35-50 % (Devyatkin, 2007). It was planned to carry out wide-ranging R&D and to put the necessary production facilities into operation by the branch ministries.

Soviet republics developed their own normative regulations, which, in fact, duplicated all-union documents, or used all-union regulations directly, or used normative regulations developed by other Soviet republics.

The regulations in the field of MSW management were developed by MHPU; regulations were supervised by the sanitary-and-epidemiologic service and were not referred to the environment protection sector. Recyclables were not considered as municipal waste, and its collection and treatment was regulated by others set of documents.

### **After 1990**

After 1991 Belarus started to develop own system of environmental legislation. Belarusian environmental legislation has two main features:

- Differentiation of legislation and approving the special codes and laws for specific natural resources, for example, Forest code, Land code, Law on fauna protection and etc.;
- Integration of legislation and approving integrated laws, for example, Law on environment protection, Law on state environmental expertise, Law on waste management and etc.

Current system of environmental legislation on WM in Belarus includes follow levels and types of legislative documents (Table 11).

Table 11: WM legislation in Belarus

<i>Legislative document(s)</i>	<i>Main statements on waste management</i>
Constitution	States (1) the right on healthy environment (art. 46) and (2) the duty of every citizen to protect the environment (art. 55)
Law On environmental protection (1992)	<p>Law was adopted in 1992. In 2002 the Law was radically revised and reworded. After 2002 the Law was revised in 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2013 and 2014, i.e. almost every year.</p> <p>The law establishes (1) the principles of sustainable use of natural resources, (2) the legal content of general and special natural resources, (3) content of rights and obligations of citizens, public associations, enterprises and organizations in the implementation of environmental policy, (4) general requirements for the protection of the environment, taking into account the specific of various human activities, (5) the value and the content of the economic mechanism in the field of environmental protection, etc.</p> <p>In regards to WM the Law establishes</p> <ol style="list-style-type: none"> <li>(1) the powers of local executive and administrative bodies in the field of WM: they establish the place of waste disposal; organize collection, transport, storage and disposal of municipal waste generated at their territory (art. 11);</li> <li>(2) requirements for environmental protection during the production, handling and disinfect of hazardous chemicals (art. 46);</li> <li>(3) requirements for environmental protection in the process of WM (art. 50).</li> </ol>
The law On waste management (1993 – first version; 2007 – the last version)	The special law on Waste management was adopted in 1993. The law (1) established the legal basis of WM and (2) has aim to prevent the harmful impact of waste on the environment and human health, to ensure and protect the rights and legiti-

	<p>mate interests of persons linked to the WM, as well as (3) to increase the involvement of waste into economic circulation as SRM.</p> <p>The law establishes power of different agencies in the sphere of WM and property rights on the waste; gives definitions and classification of waste, describes principles of WM. There are special statements about the obligations of municipalities to manage solid waste and about their duty to work out the scheme of MSW management. Also the Law has laid the mechanism for the EPR. The maintenance of landfills is also the point of the Law. The law has special chapter on WM, which includes obligations of legal and natural persons; requirements on WM of industrial waste, MSW, goods lost the consumer properties; requirements to WM during an implementation of various activities, requirements to collection, separation, storing and transportation, recycling and utilization of the waste.</p> <p>In 2007 the law was revised. There were:</p> <ul style="list-style-type: none"> <li>- Changed principles of WM. Were included priority of utilization under landfilling, the obligatory procedure of the establishment of toxic class, and access to data;</li> <li>- Added additional responsibilities of different actors;</li> <li>- Added article on the development of territorial programs on WM;</li> <li>- Added requirement of obligatory construction of facilities for extraction of SRM from the waste transported to landfill;</li> <li>- Added requirement of obligatory construction of facilities for environment protection.</li> </ul>
Decrees / Directives of President	President's Decrees / Directives link to regulations of collection of different types of waste, license of activities in the sphere of WM.
Resolutions / orders of Council of Ministers, ministries and state agencies	Long list of different documents were adopted by state authorities. They establish norms and rules of practical implementation WM policy. Some of them will be describe below.
Programs and strategies	Programs and strategies are adopted by special resolutions of Ministries and Council of Ministers. They have aim to implement specific interventions for improving WM. Under resolution of President in the beginning of 2016 the development and implementation of programs and strategies were stopped due to economic crises.
Resolutions of local authorities	Documents are adopted at the local level according to power of authority in the sphere of WM.

Instructions, rules, norms and technical standards and etc.	Documents are adopted by ministries, agencies and Council of ministers. They are mandatory for all legal and natural persons.
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Belarus was the first post-Soviet Union country which established the ban to landfill SRM as well as the implementation of the principle EPR. Belarusian legislation regulates the different types of waste (Table 12).

Table 12: Belarusian regulation for different types of waste

<i>Type of waste</i>	<i>Legislative documents</i>
Municipal solid waste	<p>In regard to management of MSW were adopted:</p> <ul style="list-style-type: none"> <li>- <b><i>Nomenclature of MSW (National Register of Legal Acts of Republic of Belarus, 2001, № 119, 8/7531);</i></b></li> <li>- <b><i>Rules for estimations of MSW norms, Resolution of MHPU and MNREP from 27.06.2003 № 18/27;</i></b></li> <li>- <b><i>Instruction on the development of schemes for WM of MSW, Resolution of MHPU № 19 from 17.04.2009;</i></b></li> </ul> <p>Instruction established the procedure of the development, matching and adopting schemes of WM in settlements of Belarus. Schemes are developed and adopted by local executive power under matching with territorial offices of MNREP and Ministry of health care.</p> <ul style="list-style-type: none"> <li>- <b><i>Instruction on the organization of selective collection, storing and transportation, Resolution of MHPU from 30.07.2003 № 26;</i></b></li> </ul> <p>The instruction established the rule: owner of solid waste must collect waste separately depends on their types and store them in special containers as well as must to exclude the displacement of harmful substances to waste. There is no instrument in hand how to implement the mentioned above rule.</p> <ul style="list-style-type: none"> <li>- <b><i>Technical standard on WM and operating rules for disposal facilities (TCP 17.11-03-2009);</i></b></li> </ul> <p>Standard is applied in the case (1) location, design, construction, reconstruction, operating, destroying the disposal facilities of solid waste; (2) EIA, (3) environmental control and monitoring.</p> <ul style="list-style-type: none"> <li>- <b><i>Sanitary rules on maintenance of settlements, Resolution of Ministry of Health care from 01.11.2011, № 110;</i></b></li> <li>- <b><i>Requirements for the location and operation of the facilities carrying out the sorting and processing of municipal waste, Resolution of MNREP and MHPU from 20.12.2004 № 38/37.</i></b></li> </ul>

<b>Hazardous waste (in general)</b>	Documents link to hazardous waste transactions ( <i>Resolution of Council of ministers from 17.01.2008 № 61 and from 23.10.2009 № 1391 with additions from 08.10.2015, № 842</i> ).
Mercury and mercury-containing waste	The list of documents in according to mercury includes: <ul style="list-style-type: none"> <li>- <i>Regulations on the procedure of accounting, storing and collection of mercury and mercury-containing waste, Resolution of Ministry of Economy, MNREP and Ministry of Health care from 31.07.1998;</i></li> <li>- <i>Sanitary rules at work with mercury, SanRaN 9-109 RB 98 and Resolution of Ministry of Health care from 12.04.2013 № 30;</i></li> <li>- <i>Technical standards on waste management rules after demercurization (TCP 17.11-04-2011) and containers for mercury-containing waste (STB 2168-2011)</i></li> </ul>
Lead storage batteries with electrolyte	Document established the procedure of collection and storing of waste ( <i>Resolution of Council of ministers from 09.03.2007 № 297</i> ).
Automobile exhaust converters	Document established the procedure of collection of waste ( <i>Letter of Ministry of finances from 20.11.2007 № 17-1-25/2107</i> )
Polychlorinated biphenyls	Document established the procedure of WM for waste ( <i>Resolution of MNREP from 24.06.2008 № 62 and Resolution of Ministry of Industry from 21.05.2007</i> )
<b>SRM (in general)</b>	Documents regulate: <ul style="list-style-type: none"> <li>- coordination of activities in the sphere of SRM management (<i>Resolution of Council of ministers from 31.07.2012 № 708</i>);</li> <li>- creation the Operator of recyclables (<i>Resolution of MHPU from 21.09.2015 № 26</i>);</li> <li>- hygiene requirements for the collection, storage, transport and primary processing of secondary raw materials (<i>SanRaN 2.1.12-61-2005</i>);</li> <li>- report form (<i>Resolution of ministry of statistic and analysis from 03.10.2008 № 230 with additions from 06.11.2009</i>)</li> </ul>
Glass, paper, cardboard, packaging	Documents regulate: <ul style="list-style-type: none"> <li>- WM of glass (<i>Resolution of Council of ministers from 06.07.2009 № 896</i>), WM of paper and cardboard (<i>Resolution of Council of ministers from 09.01.2009 № 16</i>);</li> <li>- The procedure of collecting and payment for glass (<i>Resolution of MT from 20.02.2004 № 8</i>), paper (<i>Resolution of MT from 24.02.2009 № 12</i>), packaging (<i>Resolution of MNREP from 28.08.2012 № 39 with additions from 2014</i>);</li> <li>- The assessment of the reports reliability (<i>Resolution of Ministry of statistic and analysis from 18.09.2015 № 24</i>)</li> </ul>

Scrap and waste of ferrous and nonferrous metals	<p>Documents established:</p> <ul style="list-style-type: none"> <li>- involving waste in economy (<i>Resolution of MI from 16.09.2004 № 10</i>);</li> <li>- registration, storage, use and sale of waste (<i>Resolution of Ministry of Economy, Ministry of architecture and construction, MI from 15.06.2006 № 98/12/10</i>);</li> <li>- report form (<i>Resolution of MI from 11.01.2007 № 2, Resolution of Ministry of statistic and analysis from 01.07.2013 № 57</i>)</li> </ul>
Wood waste	It is adopted regulations on use of waste ( <i>Resolution of MNREP from 06.07.1999</i> )
Waste of hydrocarbons and petroleum products	Technical standards established rules of use of hydrocarbons waste ( <i>TCP 17.11-01-2009</i> ) and the use of petroleum products waste ( <i>TCP 17.11-05-2012</i> )
Goods lost their consumer properties, package	<p>Legislative documents have aim to establish the procedures for WM of waste:</p> <ul style="list-style-type: none"> <li>- the list of producers who have responsibilities to collect and return goods lost their consumer properties (<i>Resolution of Council of ministers from 21.12.2007 № 1789, Resolution of Council of ministers from 02.12.2014 № 1123</i>);</li> <li>- the procedure of waste collection (<i>Resolution of Council of ministers from 02.12.2014 № 1124, Resolution of MNREP from 02.12.2014 № 1123</i>);</li> <li>- report form and accountability (<i>Resolution of MHPU from 18.03.2015 № 6</i>)</li> </ul>
<b>Industrial waste</b>	<p>Industrial waste has a long list of different regulations. Some of them established:</p> <ul style="list-style-type: none"> <li>- the order of the identification of hazard level of industrial waste (<i>Resolution of MNREP, Ministry of health care, MES from 17.01.2008 № 3/13/2 with additions from 20.12.2011 № 51/125/67</i>);</li> <li>- inventory order of industrial waste (<i>Resolution of MNREP from 29.02.2008 № 17 with additions from 15.12.2011 № 49</i>, and the procedure of waste norms development (<i>Resolution of MNREP from 22.11.2007 № 89</i>);</li> <li>- the order of development and adopting instruction on WM of industrial waste (<i>Resolution of MNREP from 22.10.2010 № 45 with additions from 01.10.2012 № 44</i>);</li> <li>- report form and accountability (<i>Resolution of Ministry of statistic from 19.09.2013, № 208</i>)</li> </ul>



Belarusian legislation on WM includes also regulations on:

- terms and definitions (*GOST 30772-2001*), classifier of waste (*Resolution of MNREP from 8.11.2007 № 85*), classification of waste (*GOST 30775-2001*); waste cadaster (*Resolution of Council of ministers from 19.06.2010 № 934*);
- report forms and accountability (*Resolutions of MNREP from 02.06.2009 № 33, 9.12.2008 № 112, 22.10.2010 № 44 and etc., TCP (17.02-12-2014)*);
- methodological approach to calculating damage as a result of illegal landfilling;
- landfills – ecological passport (*Order of MNREP from 08.02.1996, № 19*), technical regulations on development and maintenance of facilities (*SanPIN 2.1.7.12-9-2006, Order of MNREP from 19.01.2000, № 14/8a*), the procedure of registration of facilities (*Resolution of MNREP from 10.12.2007 № 99 with additions from 30.06.2009 № 47*).

It is evident, that Belarus has well developed legislation in the field of WM in particular if we take into account fact, that after the USSR collapse Belarus had to start from “zero” level. However, it should be noted that the legislation is needed in improving.

Firstly, we should say about confusion in definitions of solid municipal waste and municipal waste in Belarusian legislation. Removal and treatment of municipal waste is an area of responsibility not only waste producers, but local authorities. It is a main reason of distinguishing special type of waste – municipal waste (Gnedov, 2012). Definition of municipal waste is established by special Resolution of MHPU (Nomenclature of MSW). Brief look at this Resolution allows concluding that there is no a list of municipal waste types, but list of types of activities and places of waste generation. According to this Resolution, local authorities are in charge for all waste generated by population. On the other hand, there is a special position in the Classifier of waste – “waste from vital functions of population” (Classifier of waste). It means, that “waste from vital functions of population” is only small part of waste generated by population (because it generated PET-bottles (other waste type with code 5711400) or waste paper (code 1870605) and so on). In the result, local authorities are responsible for removal and disposal only part of waste, not all waste generated by citizens. The regulations on tariffs are used the term “solid municipal waste”, at the same time such position is missed in Classifier of waste.

There is confusion in distinguishing terms of removal and treatment of MSW. In fact, “MSW treatment” according to legislation on HPU is understood as “MSW landfilling”.

It is no clear definition of term “MSW removal”. It is not explanations where and for what removal is carried out. In practice “removal” means transportation of waste from places of temporary storage to landfill by special transport. As we see, under Belarusian legislation and established everyday practice, MSW – is a part of consumption waste, transported to landfills; MSW doesn’t mean type of waste, but common word to name waste generated by residents, the term “removal and treatment of MSW” means “transportation and landfilling of MSW”.

Main document on MSW management is Instruction № 26. According to art.7 of Instruction № 26 local authorities must: provide separate collection of MSW, make a decision on organization of separate collection of MSW, and create conditions stimulating recycling. At the same time, instruments and mechanisms are not established. Instruction № 26 provides requirements to temporary storage of MSW (art. 8) and rules for containers allocation (art. 9). These articles contradict each other.

Art. 19 of Instruction № 26 establishes criteria for landfilling MSW: waste could be landfilled if it has a share of recyclable 5 % and less. At the same time there is no procedure how to monitor or control this criteria and what should be done, if the share of recyclable more than 5 %.

There is no special definition of WEEE in Belarusian legislation; there are no special regulations for this type of waste. WEEE consists of ferrous and non-ferrous metals, plastic, precious metals, glass, rubber, and other fractions. Therefore, WEEE treatment is regulated by various groups of legislative documents: general legislation on WM, legislation on precious metals turnover, legislation on ferrous and non-ferrous metals recycling (Gnedov, 2012).

There is no clear definition of bulky waste. This type of waste is mentioned in Instruction № 26 and Sanitary rules on maintenance of settlements, but due to unclear definition and lack of statistic accountability bulky waste is not collected and fixed in reports.

It should be mentioned, that HPU statistics uses data in m<sup>3</sup>, but recyclables fixes in tons. That why it is quite complicate to compare data. Usually for recalculating m<sup>3</sup> in tons is used factor 0,2. As a result, the inaccuracy of figures increases.

Current legislation and established practice suppose that only organization is in charge for removal and disposal of MSW in settlement. There is no distinguishing of mentioned functions, but it could be helpful to make it for attracting private companies to sector and improving MSW management (Survey..., 2016).

In spite the fact, that Belarus was one of the first post-Soviet countries established principle of EPR, there is a lack of regulations in this field. Instruments for practical implementation of principle were started to develop in last 3 years, they have a lot of gaps and mismatches.

Regulations, laws and norms are implemented through programs and strategies on improving the WM in Belarus. During last 25 years were implemented 7 programs on WM:

- ***Program of environmentally and economically sound management of waste, Resolution of Council of ministers from 02.09.1994 № 39;***
- ***Concept. Disposal, processing and recycling of municipal solid waste (MSW) in the case of Belarus, Order of MHPU from 05.09.1996 № 105.*** Concept was included review and analysis of methods and approaches to WM of MSW, its disposal, processing and utilization;
- ***Republic program on WM of MSW, Resolution of Council of ministers from 01.09.1998 № 1368.*** Program established practical interventions for sanitary cleaning of large and big cities and regions in the whole, as well as organizational, technical, economic and legislative measures for improving WM of MSW. The list of program indicators includes:
  - number of special transport and container equipment (increasing from 63 % in 1997 to 100 % in 2005);
  - level of separate collection of MSW (increasing from 0,1 % in 1997 to 50 % in 2005);
  - level of utilization of SRM (increasing from 0,4 ths t in 1997 to 830 ths t in 2005);
  - disposal of waste (1) on unequipped landfills (decreasing from 62 % in 1997 to 0 % in 2005); (2) on landfills (decreasing from 33 % in 1997 to 17 % in 2005), (3) on sorting stations (increasing from 0 % in 1997 to 26 % in 2005); on industrial enterprises (increasing from 5 % in 1997 to 4 % in 2005).

Due to different reasons, the program indicators were not achieved.

- ***National plan on rational use of natural resources and nature protection of Belarus on 2001-2005, Resolution of Council of ministers from 21.06.2001, № 912.*** Objectives of the plan in the sphere of WM are:
  - improving the legislation on WM;
  - development and implementation of environmental friendly and low-waste technologies;
  - development of methods, technologies and way of disposal of hazardous waste and their use as raw materials.
  
- ***Sectoral programme on WM of MSW on 2007-2010, Order of MHPU from 10.08.2007, № 153.*** The overall objective of the program is to prevent adverse environmental impacts associated with municipal and hazardous waste. Specific objectives in these two areas are: (i) to ensure coverage in 100 % of population in large cities by separate municipal waste collection, and to maximize the recovery of valuable materials; and (ii) effective management of high priority chemical pollutants, specifically POPs. The list of indicators stated achieving in the end of 2010 next figures:
  - number of special transport and container equipment – 100 %;
  - level of separate collection of MSW – 100 %;
  - level of separation and utilization of MSW – 14 %;
  - amount of collection of SRM – 280 ths t;
  - coverage of sanitary cleaning of rural settlements – 100 %.

The most indicators were not achieved to 2010.

- ***State program on construction of protection facilities at the existing landfills for preventing environment pollution by waste, products their interaction and (or) decomposition on 2008-2014, Resolution of Council of ministers from 05.03.2008 № 333,***
- ***State program of collection (provision) and utilization of secondary materials in Belarus on 2009-2015, Order of President of Belarus № 327.*** The programme states the main directions of work, priority actions in collecting waste and its use

as SRM as well as prevention of the environmental pollution through waste management issues. The Programme provides the basis for improvement of the regulations, SRM management, waste prevention and increasing of their use as recycled materials, stimulation of collecting and use of SRM, carrying out measures for increasing of public awareness. Nowadays the scheme for MSW management is under consideration;

- ***Concept of WM of MSW and recyclables in Belarus on 2014-2020, Order of MHPU from 07.07.2014 № 78.*** Main objectives of the Concept are:
  - ➔ analysis of best practices in the sphere of WM of MSW and extraction of SRM;
  - ➔ assessment of current state of WM of MSW and recycling in Belarus;
  - ➔ establishing measures of effective WM of MSW.

Indicators of the Concept implementation:

1. Extension of the range of SRM from the MSW.
2. Sorting and recycling of not less than 1 mln t /yr of MSW.
3. Providing collection of not less than 815 ths t of SRM across the republic by the end of year 2020.
4. Proving the break-even work of HPU for the population according to cycle of MSW management (collection, removal, sorting, recycling, decontamination, disposal).
5. Attraction of private investment in the sphere of removal, recycling and treatment of municipal waste for the individuals and legal entities.
6. The achievement of the fixed rates in accordance with the President Decree from July 11, 2012 № 313 "On some issues of the treatment of municipal waste."

According to the Strategy of the Collegium of the MNREP (№ 8-r from 28.01.2010) in the field of the environmental protection for the period until 2025, the following tasks were set:

- providing 100 % coverage of separate collection of MSW for the population;
- setting up the system of collection, using and (or) decontamination of the population household appliances and other goods lost their consumer properties, including waste with hazardous substances, for the period until 2016;
- providing full, regular and planned removal of domestic waste for urban and rural population;
- improving the system of separate MSW collection considering the extraction of at least 70 % of SRM of the total waste generation;
- construction of waste recycling plants in Minsk, regional centers and cities with population over 100 thousand people by 2016, cities with population over 70 thousand people – by 2025;
- construction of facilities that using combustible fractions of waste as a fuel to produce electricity and heat, as well as facilities for composting of organic component of MSW in the city of Minsk, regional centers and cities with population over 100 thousand people by 2016, cities with populations over 70 thousand people – by 2025;
- extraction of landfill gas at the municipal landfills considering an economic efficiency;
- setting up collection, use and (or) treatment of goods lost their consumer properties and containing hazardous substances by 2012.

At present, the interventions of program, for example, construction of recycling plants or composting of organic waste postponed indefinitely due to economic crises.

Territorial waste management programs are developed by local executive and administrative bodies and approved by the local Councils of deputies. Territorial waste management programs are divided into regional (Minsk City and Oblast' programs) and district (municipal) programs. The duration of the waste management programs is 5 years usually. Territorial waste management programs include parameters of the collection of SRM and their use. Furthermore, territorial waste management programs include

measures to achieve these parameters, measures for the construction of storage facilities, facilities of waste burial and treatment, as well as other measures, which are necessary to reduce the harmful effects of waste on the environment and residents' health and their property.

### 11.2.2 Development of waste management situation and infrastructure

#### Before 1990

##### Data and its availability

At present, the data on the MSW management system in the BSSR is practically not saved. The official representatives of statistics agencies say that almost all reports were sent to Moscow and were not kept in Belarus. The enterprise documentation was handled in the archive and it is too hard to become familiar with it. In the course of political transformations a lot of documents were lost. It should be mentioned that the soviet statistics did not collect in-depth information on MSW management, and this field was given insignificant consideration.

##### General scheme of municipal waste management

Municipal waste was divided into solid and liquid ones. The solid waste included the waste of the human life activities, the waste of current apartment repairs, waste of local heating system, waste from yard territories and bulky waste, as well as waste of cultural, housing, health care and others public facilities. The liquid waste included sewage (feces, slops) collected in the buildings without sewerage system.

MSW management was carried out in accordance with the "plan-regular system of collection and removal of municipal waste" which included:

- ➔ preparing the waste to loading into waste collector vehicles;
- ➔ organizing temporary storage of the waste in households;
- ➔ treatment and utilization of the municipal waste.

In general, mixed waste was collected. Organic waste and recyclables (glass, paper and cardboard, ferrous and non-ferrous metals) were collected separately. Recyclables were

not “waste”, they were calculated separately from MSW. Most of waste was transported to landfills, and only insignificant part of it was treated (composting or burning).

Some part of industrial waste was transported to municipal landfill too. Industrial plants with waste of III and IV dangerous class could receive permission on removal and land-filling industrial waste at municipal dump. This permission was given by the local sanitary-and-epidemiologic services and the fire preventing inspections. The issue of the quantity of industrial waste accepted at the landfill was decided by the municipal HPU on the basis of local conditions (availability of territory for storing, provision of machinery). The general quantity of incoming industrial waste had not to exceed 30 % of the daily income of all waste.

### MSW generation

Data on MSW generation in cities of BSSR and area of landfills are provided in the Table 13.

Table 13: MSW generation in the cities of BSSR

Indicator	1977	1980	1985	1990
Urban population, ths per	5012	5362	6077	6762
Amount of MSW, ths t per cap	1071	1219	1488	2358
Area of landfills for MSW, ha	450	460	600	800

### Waste composition

The study of the morphological composition of the MSW was carried out by a few waste treatment facilities with the aim to develop technologies for treatment and disposal. Morphological and chemical composition of MSW is provided in Table 14 and Table 15 respectively.

Table 14: Morphological composition of MSW\* (Sanitary cleaning..., 1990)

Component	Composition, % of the mass



Paper, cardboard	25-30
Food wastes	30-38
Wood	1,5-3
Ferrous metal	2-3,5
Non-ferrous metal	0,2-0,3
Textile	4-7
Bones	0,5-2
Glass	5-8
Leather, rubber	2-4
Stones	1-3
Plastic	2-5
The rest	1-2
Siftings (less than 15 mm)	7-13

Table 15: Chemical composition of MSW\* (Sanitary cleaning..., 1990)

Component	% of dry mass
Organic matter	56-72
Ash content	28-44
Total nitrogen	0,9-1,9
Calcium	2-3
Carbon	30-35
Phosphor	0,5-0,8
Total potassium	0,5-1
Sulfur	0,2-0,3

Medium reaction, pH	5-6,5
Humidity, % of total mass	40-50

### Waste collection and transportation

The organization of "plan-regular system" and regime of removing of municipal waste were established by Resolutions of City executive committees on the proposal of the HPU plants and sanitary-and-epidemiologic services. Frequency of MSW removing was depended on season, climate, and epidemiologic situation. The regime of removal was discussed with the local sanitary-and-epidemiologic services and approved by Resolution of City executive committee.

As a rule, the next terms of the municipal wastes removal were set up:

- ➔ from the household territories - once every three days;
- ➔ from the household territories with a special regime – every day.

Collection and removal of municipal waste in the cities were carried out by special automobile enterprises (SAE) (as a rule, the only in the city; they combined functions of collection, transportation and treatment; SAEs had state ownership) in accordance with approved schedules and outlines. Construction waste was transported by construction companies to "specially appointed plots".

The area of responsibility of SAE included services on removal and landfilling in residential housing, retails, catering, cinemas, sewing workshops, hospitals, hotels, campuses, kindergartens, schools and other educational institutions, theatres and markets. Sometimes, SAE could serve departmental housing stock and industrial enterprises with local subordination.

The main approach to collect and remove MSW were:

- ➔ container system (the system of "replaceable" containers);
- ➔ the system of irremovable containers.

In accordance with container system, the waste was removed with containers, and new empty containers were put on their places. In accordance with irremovable system the waste was put directly into special cars and after that the containers were put on their places. In improved housing areas the container system and irremovable system could be used simultaneously. In private housing area more often collection and removal of MSW was carried out in specific days, when special cars collected unload waste boxes from residents.

In accordance with the system of replaceable containers the container capacity was 0,75 m<sup>3</sup>; and cars by model M-30A were used. In accordance with the system of "irremovable" containers the container capacity was 0,75, 0,6 and 0,55 m<sup>3</sup> or 0,3 m<sup>3</sup> (for roll-in-containers). The removal of waste was made by cars of different models.

In large cities separate collection of food waste was organized, in some cases collection of bulky waste was carried out.

Bulky waste was defined as waste due to its size can not put in standard container with capacity 0,75 m<sup>3</sup>. According to data (Sanitary cleaning..., 1990), about 25 % of bulky waste was ordinary municipal waste with linear size less than 250 mm which by some reasons went into container for bulky waste. For collection and removal of bulky waste special cars were produced with displaceable storage hoppers and capacity 5,5-12 m<sup>3</sup>. These containers were installed at special sites in housing area. Removal of bulky waste could be carried out by according to schedule as well as according to claims of the residents. The burning of bulky waste was strictly prohibited at housing area.

Norm of food waste generation was 30 kg/person per year. Organization of collecting food waste was started from allocation of special home boxes (with capacity 10 l or 20-25 l). Boxes with capacity 10 l was used in low-story housing area or in the case door-to-door system of waste removal. In multi-story housing area boxes with capacity 20-25 l were used. Boxes for food waste were bought and repaired by bureau for harvesting of un-planned feed at the expense of pig fattening farm (these expenses were included into the cost of collection of 1 ton of food waste).

The food waste removal from houses could be organized in three ways:

- ➔ the food waste was delivered by the collect workers into the yard litter boxes;
- ➔ the food waste was thrown out by the tenants into the yard litter boxes;
- ➔ the food waste was thrown out by the tenants directly into the vehicle according to the door-to-door waste collection and removal system.

Collected food waste was transported to fattening farms where it was heat-treated (boiling, drying) and also cleaned from the worthless stuff and after that was fed by the kettle.

### Treatment

There were 9 WTP in the USSR. 20 facilities were under construction in 1990, but it is unknown whether they were launched. WTP used technology of aerobic biometric composting. Characteristics of the 9 exactly working facilities are given in the Table 16.

As follows from the Table 16, in the Soviet time there were 2 plants producing biohumus which with varying success are still existing in Belarus; as well as 3 plants were located in Russia, and 1 in each republic in Kazakhstan, Uzbekistan, Azerbaijan and Georgia.

Table 16: The operation data of waste treatment facilities working in the USSR

Indicator	Lenin-grad	Mos-cow	Tash-kent	Minsk	Alma-Ata	Baku	Tbilisi	Mogi-lev	Gorky
Startup year	1971	1972	1977	1978	1981	1983	1984	1974	1987
Capacity, thousand ton per year	200	110	80	80	65	65	40	34	40
Compost and bio-fuel output, thousand ton per year	140	35	50	60	40	40	30	20	22
Ferrous metal output,	3000	1600	1500	1500	1000	1000	1000	500	600

ton per year									
Pro-cessing cycle time	2	4	2	2	2	2	2	2	2
Occu-pied area, ha	8	6	5,9	4,5	5,8	6	5	4,5	5,7

### Landfilling

Landfilling of MSW was the main method of waste "treatment". It was distinguished 2 types of landfills: organized and unorganized (illegal in modern terminology) which were located near every settlement. For a long time, landfills had no environmental requirements to their design, and the first environmental standard for the design of landfill had very short list of such requirements. In practice, many of these requirements were not met. Number of landfills, the amount of accumulated waste was not taken care by HPU or environmental agencies. The subject of statistic reporting was amount of removed waste (municipal and industrial). Control and monitoring of removed waste was carried out by treatment and disposal facilities (landfills, treatment plants, incineration plants and etc.). Control and calculations should be done based on actual measuring, but at the same time many landfills were not equipped by weights, that why amount of removed waste was written down based on theoretical calculations of "norms of waste generation". Formally, city department of HPU approved annually and took to the landfill the list of serviced industrial enterprises with identification of waste types and allowed amount for landfilling. Laboratories at the landfills should check and make random monitoring of delivered industrial waste once a quarter from each company. At the same time, most of landfills did not have laboratories, so control and monitoring was not carried out at all.

There is no available data on number of landfills and amount of collected and stored waste in BSSR.

Recycling

Until 1990, in the USSR there was system of "Gossnab", which was in charge for collection, calculation and use of recyclables. It was strong belief that the use of recycled materials is a powerful factor of resource saving. The special institute of recycling materials was established to provide effective scientific and engineering assistance for resource saving approaches and use of SRM.

Recyclables were collected by 4 departments (Glavk):

- Glavvtorsyr'e (Ministry of light industry) – collection of recyclables in cities and working settlements;
- Tsentrosoyuz – collection of recyclables in rural areas;
- Glavvtorchermet (Ministry of Ferrous Metallurgy) – collection of recyclables at industrial enterprises and farms;
- Glavsvetmet (Ministry of non-ferrous Metallurgy) – collection of recyclables at industrial enterprises and farms.

It was established quite powerful special industrial infrastructure for the collection and industrial treatment of the main types of secondary raw materials over the whole area of the USSR.

Only the system "Soyuzvtorglavresursy" of Gossnab in the 1980s included (Devyatkin, 2007) 527 enterprises of SRM and 5677 collecting points for recyclables from the population:

- Enterprises for treatment of waste paper - 4;
- Enterprises for treatment of textile - 80;
- Enterprises for treatment of polymers - 8;
- Production and harvesting plant, and harvesting and manufacturing bureaus - 471 of them with functions of treatment - 32;
- Collecting points - 5 677 of them are stationary - 3793, mobile - 1884.

The collection, treatment and recycling of SRM in the cities and towns was carried out by about 40 ths specialists of the "Gossnab" (Zakharov et al., 1980). The level of waste paper collection in the system was around 59 %, textile – 51 %, bones – 43 % of used

tires – 31 % (all figures are given in relation to the urban population by the end of 1978) (Zakharov et al., 1980).

Collection of recyclables from residents was organized through the usual collecting points, combination of collecting points and shops (points-shops) and HPU sites (Zalkind et al., 1985). The most common form was points-shops. They exchanged collected recyclables on consumer goods. In 1979 there were 1092 points-shops in the system of “Gossnab” (Zakharov et al., 1980). Positive aspects of the organization of the points-shops were: (1) increasing amount of collected recyclables; (2) significant improving the quality of collected recyclables; (3) relative reduction in the number of employees per unit of collected recyclables; (4) engaging high qualified staff; (5) improving service culture; (6) educational impact on population. It was fixed significant growth of collected paper and cardboard from residents since the starting of points-shops (October 1974). During next 5 years additional 800 thousand tons of waste paper was collected (Zakharov et al., 1980). The average amount of collected recyclables in points-shops was in 2 times more than in the usual collecting points. However, this method did not give a significant growth of total collection of recyclables and led to redistribution of resources in the places of their generation. Mobile collecting points allowed to collect in 2-3 times more recycled materials than stationary (Recycling materials, 2015).

Collection of recyclables through HPU sites was based on the agreement between HPU sites and Production and harvesting plants. Collected recyclables at HPU sites were characterized by: (1) higher cost for collection (about 17 %); (2) lower quality. Collection of recyclables at HPU sites was carried out by yardmen or by special staff or by brigadier method. The brigade served part of the housing area. Collected recyclables were stored in special room. On the request of the brigade recyclables were transported to Production and harvesting plants.

In the former USSR it was collected about 90 % of glass, on which there was a collateral price. Points for glass collection were placed everywhere, and at the any store you could buy goods without cost of glass (if you have glass for exchange, of course).

There is no available data on amount of collected recyclables, and their use in BSSR

**After 1990***Data and its availability*

Information about generation and use of industrial waste is a subject of the state statistical observations made on Form 1- waste (MNREP) "Report on the Treatment of Industrial Waste". The form is submitted by legal entities engaged in activities related to the treatment of industrial waste, except for legal entities which have only waste products similar to "waste from vital functions of population", with a total volume of such waste not exceeding 50 t / yr. State statistical reporting on Form 1- waste (MNREP) is used in the preparation of statistical compilations, national reports and bulletins on the environment, other regular information publications.

State statistical observations provide data on the number of generated industrial and removed solid municipal waste, i.e. there is no data on the amount of waste generated in households.

MHPU collects information in departmental reporting form 1- sanitary cleaning "Report on Sanitation of settlements". This data includes information on the volume of MSW collected from the public and legal entities and sent to sorting and disposal points, or collected as SRM. This data is collected annually and presented by legal entities engaged in cleaning of settlements and managing municipal waste. Also, this data is submitted to the city or district department of HPU, then – aggregated data - to the RD of HPU, after that SUE "Bel Utilities Proekt" makes a summary report for MHPU.

However, this data is not complete, as it does not reflect the quantity of waste removed by the producers of this waste themselves. National Statistical Committee publishes data on MSW quantity obtained from MHPU in the collected book "Environment Protection in the Republic of Belarus" and uploads it on the website (Towards..., 2014).

*Institutional and legal basis for data submission to international organizations:* Republic of Belarus is a Party to Basel Convention and has to submit annual report on the implementation of the Convention which includes MSW. Mentioned "**Report on Sanitation of settlements**" includes following list of indicators:

- ➔ Municipal waste disposal facilities (data on the number of facilities, installed capacity, free capacity);



- ➔ Municipal waste sorting and processing facilities (data on the number of facilities, installed capacity, volume of processed municipal waste, selection of recoverable resources, waste disposed for landfilling);
- ➔ Municipal waste collection, removal and disposal (data on the number of population covered with sanitation and cleaning services, municipal waste collection and removal);
- ➔ Collection and recovery of recyclables (data on recycling by types of materials).

Belarus managed to populate the data on municipal waste disposal from 1990. The data on the volume of municipal solid wastes processed at sorting lines, waste recycling are monitored in the country based on reporting data from 2011 only.

General scheme of municipal waste management is follow figure 42.

Almost all municipal waste is collected together (mixed waste) and are transported to the landfills. Waste separately collected in special bins is transported to the sorting stations, the remainder is sent to landfills. SRM in a good condition are collected by the system of consumer cooperatives at the collecting points for recyclables, but the list of such SRM is limited (waste paper, metals, textiles) and the purchase prices do not encourage people to give them away. The redistribution of SRM from the container system to the system of collecting points takes place in case when two systems are working in parallel. The most common method of management of municipal waste is still landfilling. The costs and benefits of various WM alternatives (especially the environmental impacts and costs) are not taken into account in the WM planning process in Belarus.

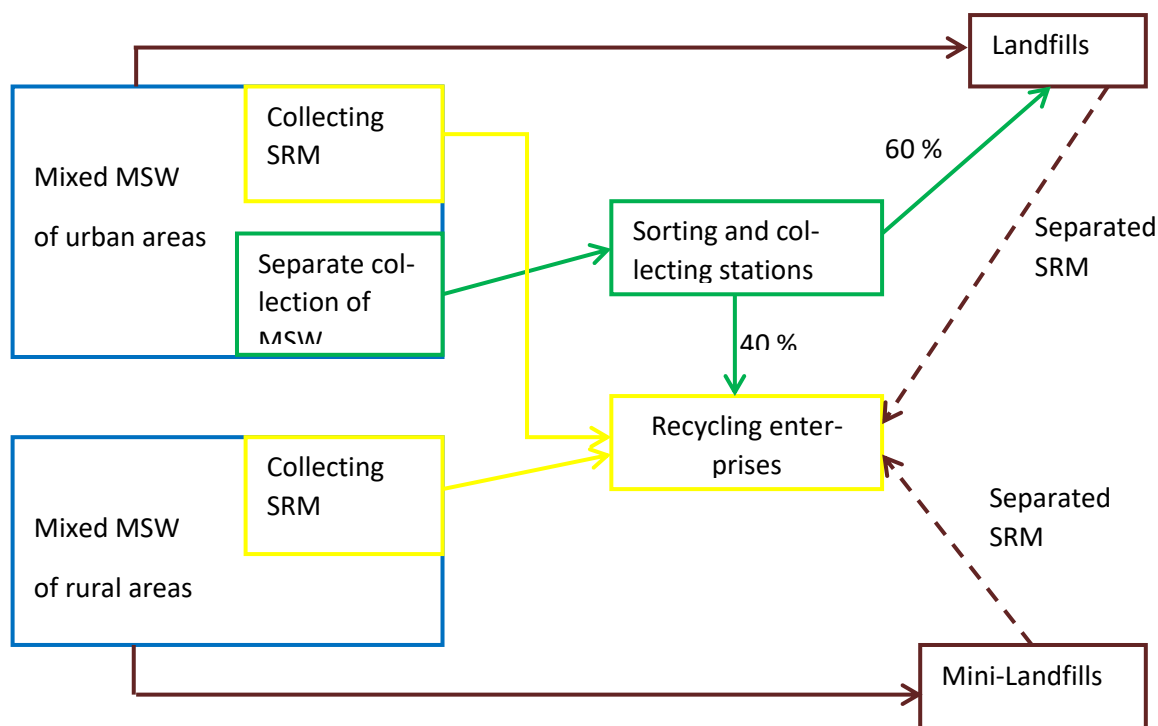


figure 42: Scheme of MSW management

MSW generation

MSW generation is continuing to increase over the past years (figure 43). With higher incomes and rising consumption, MSW generation have steadily increased since 1995 (by almost 2,5 times). Waste generation per capita has increased almost 3 times: from 143,5 kg per cap per year in 1995 to 421,7 kg per cap per year in 2014 (figure 43).

Waste composition

The composition of different components and materials in the MSW is represented in figure 44. The food waste, paper and cardboard have share about a quarter of the mass. Metals, glass, polymers have a considerable share in the waste. Recycled materials and valuable resources components have two thirds of the waste. Seasonal variations of the composition of MSW are characterized by variability of the food waste from 20 – 25 % in the spring to 40-50 % in the autumn.

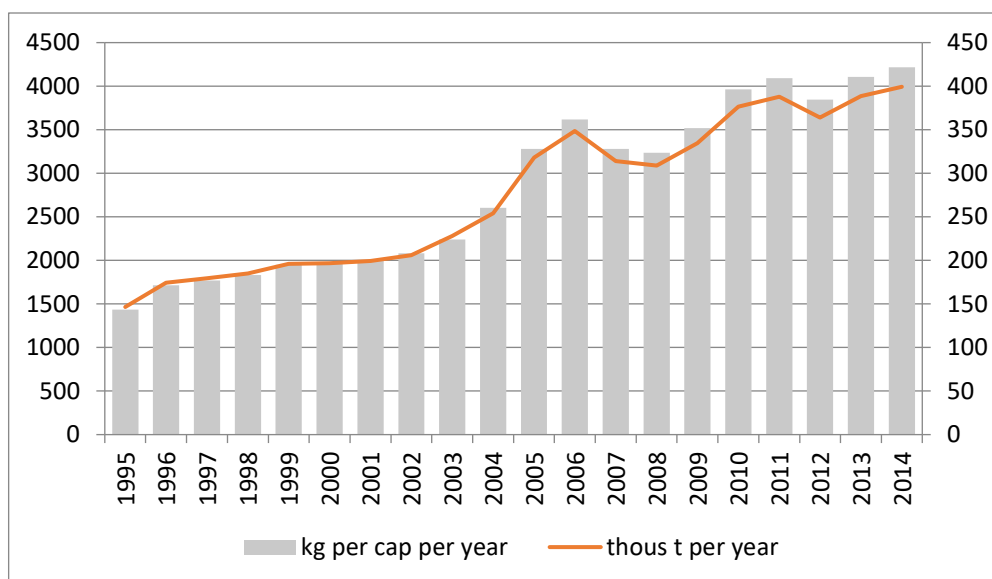


figure 43: MSW generation in Belarus (based on [state statistic data](#))

Considering the trend of MSW composition, one should note increasing the dangerous waste due to staidly rising of consumption of household chemicals, car care products, chemical weed and pest killers and etc. The amount of the polymer waste is fixed. The composition of various polymers in MSW is presented in Table 17.

Table 17: Composition of polymers in MSW\* (Lysuho&Eroshina, 2011)

Polymer	Polymer fraction share in the waste composition, %
Polyethylene	48,3
Polypropylene	7,1
Polystyrene	6,9
Polyvinilchloride	4,0
Polyethylene terephthalate	25,4
Polyurethane	1,1
Polymethylmethacrylate	1,1
Mechanical rubber waste.	4,2
Other polymers	1,9

Polyethylene and polyethylene terephthalate, which total share is about 74 %, obviously dominate in the composition of MSW.

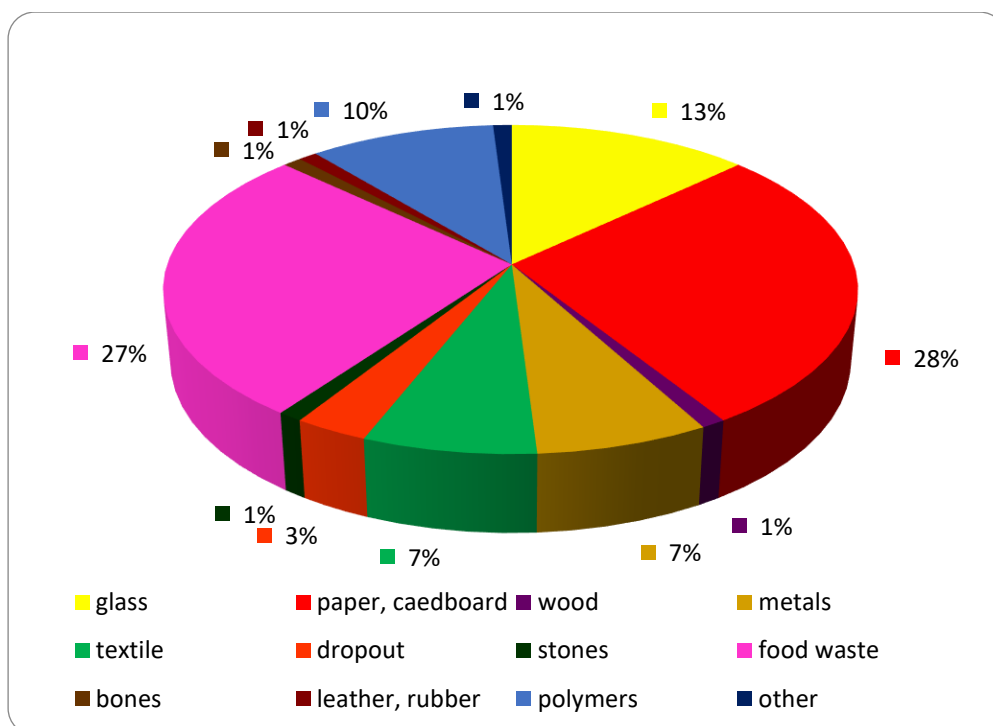


figure 44: MSW composition (Lysuho&Eroshina, 2011)

Averaged chemical composition of mixed MSW, humidity and ash content is presented in Table 18. The mixed MSW has high humidity and ash content which are made recycling more complicate.

Table 18: Chemical composition of MSW (Lysuho&Eroshina, 2011)

Component	Amount, % of dry mass
Organic mater	56-72
Total nitrogen	0,9-1,9
Calcium	2-3
Carbon	30-35
Phosphorus	0,5-0,8

Total potassium	0,5-1,0
Sulphur	0,2-0,3
Medium reaction, pH	5,0-6,5
Ash content	28-14
Humidity, % total mass	40-60

### Waste collection and transportation

The collection, removal and disposal of MSW was organized in 18187 settlements (2013), including 191 cities, and 17988 rural settlements ([Concept of WM of MSW](#)).

Cities and towns (in total 21) are covered by sanitary cleaning on 100 %, rural settlements – on 56 % (that is on 10 % lower than the average rate for Belarus), and garden cooperatives and associations – on 71 %, slightly above the average rate for Belarus. So far, the coverage by sanitary cleaning of rural settlements and garden cooperatives increased slightly, but still has not reached 75 %.

HPU organizations have (2013) 1792 specialized cars for sanitary cleaning of settlements ([Concept of WM of MSW](#)). The number of specialized cars in Mogilev region was increased by 15 %, from 156 to 185 cars during 1997 - 2013. Almost all cars (90 %) have side-loading system. Due to the increasing the consumption, rising of private cars stored near the multi-story houses, the modernization of specialized cars is needed. Cars with back-loading system are the most appropriate for small and cramped courtyards. A fleet of vehicles is needed in updating: about 30 % of specialized cars are older than 10 years. The demand in new cars in Mogilev region is 40 vehicles per year, 10 of them are for separate waste collection.

Metal containers are usually used for collection of MSW. They have volume from 0,6 m<sup>3</sup> to 1,1 m<sup>3</sup> mostly, but the large one (12 m<sup>3</sup>) is under operating also. About 114 thousand containers are used by HPU organizations for the sanitary cleaning in Belarus; 50 thousand of which are containers for separate waste collection (12,2 ths containers were installed in 2012). During 5 years (2007-2013) the number of containers was increased by almost a third – from 73,2 to 114 thousand items. The number of containers in Mogilev region (2007) is presented in Table 19. The share of containers for separate waste collection is 15 %, i.e. the number of such containers is not enough. Almost all containers have volume of 700 l. The demand in new containers in Mogilev region is about 3000,

about half of them are containers for separate waste collection. According to the [data of RD of MHPU](#) the total number of containers reached 11,7 thousands in 2015. All container sites in multi-story housing area were equipped with containers for separate waste collection. During 2015, 2313 containers were bought. With help of containers for separate collection was collected 9,2 % of recyclables from its total amount.

Table 19: Number of containers for mix and separate collection of MSW in 2007 (Sectoral programme)

Region	Number of container sites	Number of installed containers	Including containers for separate waste collection	Including from previous column					
				700 liters		240 liters		120 liters	
				Total	Including containers for separate waste collection	Total	Including containers for separate waste collection	Total	Including containers for separate waste collection
Mogilev region	2175	8614	1357	8526	1307	58	20	30	30
Belarus	14500	73165	24836	62683	15126	6537	6120	3945	3590

Coverage of urban population by separate waste collection was 3,8 % in 2003; 13,1% in 2004, 34,8 % in 2005 and 42,3 % at the end of 2006 ([Sectoral programme](#)). According to data of 2008, separate waste collection system covered 45,8 % of urban and 14,4 % of rural population in Mogilev region (Table 20).

The current system of separate collection of MSW is focused on the traditional separation of SRM (paper, cardboard, plastic, glass) by installing special containers. Separate collection system of MSW has the following problems: (1) the installation of containers are spontaneous; (2) there are no approved schemes of container allocation taking into account the density of the population, the density of houses, architectural features and etc.; (3) there are no uniform requirements to containers for separate waste collection; (4) vandalism and the cultural level of citizens (in cases where usual containers for mixed waste filled up, some of citizens put away their waste to containers for separate waste collection). The quality of waste, collected in special containers is much worse in compare with the quality of waste separation at special legal entities or individual entrepreneurs. The costs on additional work (sorting) of waste from special containers are significant.

Table 20: Coverage by separate waste collection in 2007\* (Sectoral programme)

Region	Cities and towns				Rural settlements				
	Number	Population, thousand pers.	Coverage of urban population by separate waste collection, thousand pers.	% of coverage.	Number		Coverage of rural population by separate waste collection		
					Number	Population, thousand pers.	Number	Population, thousand pers.	% of coverage.
Mogilev region	21	851,3	389,9	45,8	3099	317,9	141	45,7	14,4
Belarus	188	6976,6	2951,1	42,3	16235	3034,639	743	233,27	7,7

### Sorting MSW

Sorting stations can be integrated into the existing scheme of collection, removal and disposal of waste from the population, as well as the process of waste separation could

be mechanized at such sorting station. It should be noted that the construction of sorting stations associated with significant investment in compare to the system MSW separate collection at the places of generation.

According to Concept of WM of MSW in 2013 in Belarus there were 90 sorting stations with total capacity about 350 ths t/yr. 5 sorting lines as the part of WTP were built in Gomel, Mogilev, Baranovichi, Brest and Novopolotsk with capacity about 300 ths t/yr. The construction of these sorting stations was funded by Belarusian government. Private and foreign investments were not attracted. During 10 years (2003-2013) the number of sorting stations was increased by 15 %: from 77 to 90. Almost all sorting stations were introduced into operation in 2005-2006. Main features of sorting stations are provided in figure 45

In 2013, about 270 ths t of mixed MSW were separated at the sorting stations and WTP (or about 10 % of the MSW generation). The extraction of recycled materials was 51 ths t, or about 19 % of the MSW received for sorting ([Concept of WM of MSW](#)). The rest volume of MSW is a part of the ballast and is transported to landfills. The sorting of mixed MSW is ineffective, because the cost of the sorting more than 2 times higher than the benefit from the sale of recycled materials (due to low quality of SRM). Efficiency of sorting stations is much higher if the already separated MSW are treated.

### Recycling and treatment

In addition to the collection of separate waste in places of its generation the harvesting the recyclables at the collecting points of "Belcoopsoyuz", concern "Belresursy" and Minzhilkomhoz is carried out. The system of collecting points of "Belcoopsoyuz" is a leader in the harvesting of such recycled materials as paper, textile and glass. However, the business of collecting SRM faces a number of difficulties. Firstly, the low purchase prices do not encourage people to use the opportunities of collecting points. Secondly, the network of collecting points has very uncomfortable location due to formal regulative requirements. Thirdly, collecting points are very little equipped by special presses, crushers and etc.

According to the statistic data (2011), there are 1283 collecting points were registered in Belarus, 896 of them are stationary, and 387 – mobile. In 2014, the number of collecting points was reduced to 894. Their total capacity is 450 t/yr ([Concept of WM of MSW](#)).

About 80 ths t of SRM are annually collected at collecting points. Widespread types of collected SRM are paper and cardboard (75 % of the total amount). For comparison: the



dominant type of collected SRM through the system of special containers is plastic (74 %). Waste collected through collecting points has high quality. However, the cost of waste collection at collecting points is much higher than the cost of collection through the system of special containers. That why poor takes away SRM from special containers and earns money at the collecting points for recycled materials. This reduces the efficiency of both systems.

Recycling facilities are usually built for environmental reasons and require governmental subsidies in their construction and operation. Recycling facilities are listed in a special Register. The Register is kept by MNREP and uploaded at its web-site. The register must be used by all waste generators in the procedures of the development of instruction on WM, as well as territorial offices of MNREP in the procedures of approval and control of norms of waste generation, limits of landfilling and etc. Register is made in accordance with the nomenclature of the waste from Waste classifier. In the case, when at least one treatment facility operates with the certain kind of waste, the last one could not be land-filled (one exception – the official refusal of recycling plant). Register is divided into three parts: facilities for the (1) disposal, (2) recycling and (3) landfilling. The list of recycling facilities includes about 500 plants (which take waste from other legal entities or individuals). The structure of treatment facilities (% of total number of registered objects) is shown in figure 45: Recycling facilities in Belarus. Recycling plants treat 941 kind of waste. The larger part of recycling materials is plastic (23 %), wood (20 %), construction waste (15 %), oil products (14 %). Totally, share of mentioned types of waste is about ¾ of recycled materials.

#### *Paper and cardboard.*

About 90 % of paper and cardboard is collected at collecting points. Currently, the main consumers of recycled paper are 7 companies which are part of the Belarusian production and trading concern of forestry industry. The total demand in the recycled paper is about 430 ths t/yr.

#### *Glass.*

Annual volume of generated glass waste is 150 - 200 ths t. About 20 ths t of glass waste is generated in the industrial sector and moved to the enterprises of the glass industry directly. Based on morphological and fractional composition of municipal waste, MSW contains about 130 - 150 ths t of glass waste. The main consumers of glass waste are

Glass factory "Elizovo", "Belevrotara", "Gomelsteklo", "Brest KSM", "Grodno Glass". The glass waste is used as additive material to the basic components of glass.

### Plastic.

Annual volume of generated plastic waste is about 300 ths t. Plastic waste consists of:

- plastic packaging, including bottles made of polyethylene terephthalate (PET), 31 ths t;
- polyethylene and polypropylene films - 100 - 120 ths t;
- other waste (plastic parts of household appliances, kitchen utensils, toys, sports equipment, linoleum, pipes, etc.) - 150 ths t.

Since 2003 Belarus has built plants for recycling of plastic waste with total capacity of 16 ths t. At present times, these plants are underused due to lack of raw materials. About 4 ths t of plastic waste (PET) are annually collected and recycled in Belarus, or 20 % of generated of such type of waste. The level of recycling for other kind of plastic waste is only 12-14 %. The large part of plastic waste generated in households is heavily contaminated and consists of destructed polymers. All of these make the recycling more complicate and expensive.

### Textile.

According to experts, annual amount of textile waste is about 150 ths t. About 6 ths t is generated at the factories of light industry and moved directly to recycling facilities. Recycling of textile waste is carried out by plants, which are the part of the group "Bellegprom" and "Belcoopsoyuz". Production capacity for processing of secondary textile materials is about 10 ths t / yr in the country.

In 2013 the aggregate demand in paper waste was estimated at 392 ths t / yr while the collection was 28,4 ths t / yr. The demand in glass waste was estimated at 145 ths t, while the collection was equal to 83 ths t. The textile waste collection capacity exceeds processing capacity by three times (Survey..., 2016).

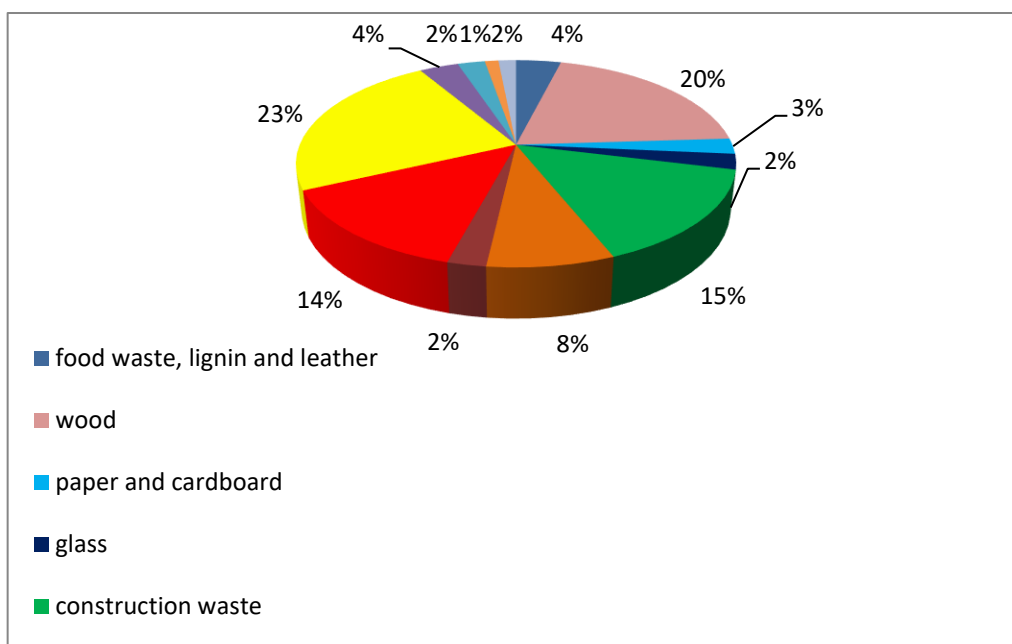


figure 45: Recycling facilities in Belarus

### Electronic waste.

Annually, about 150 thousands of refrigerators, 260 thousands of TVs, 90 thousands of washing machines are broken and out of operation. The system for collection and recycling of electronic waste is under construction in Belarus. The amount of collected waste is very low.

### Automobile waste.

Waste generated by vehicles belonging to individuals consists of two components (1) the waste generating during the operation of the vehicle and (2) the waste generated during the disposal of vehicles. The annual number of autos needed in recycling is 50 thousands. Deferred demand in auto recycling (accumulated fleet vehicles which are out of operation) at the current moment is about 200-250 million units and continues to increase. The annual amount of waste generated during the operation of autos, are: oil - 13 - 15 ths t; brake and cooling liquids – 0,5 – 1,0 mln t; used oil and fuel filters – 1,7 – 2,0 mln t; defective batteries – 2,5 – 3,0 mln t. Such waste is almost not utilized from population in Belarus.

### Used tires.

Every year about 64,5 ths t of used tires are generated in Belarus. Currently waste tires used as alternative fuel by public company "Krasnoselskstroyaterialy" and by "Belarusian Cement Plant".

### Hazardous waste.

Galvanic elements are the most common type of hazardous waste generated at households. The total amount of their generation is about 3,7 ths t/yr. Currently, the collection of galvanic battery waste from population is at the stage of the installation of special containers. Advanced technologies for utilization of galvanic batteries are not available. The 1000 containers were installed in shops and some public organizations. The specific problem is mercury-containing waste in mixed MSW. Assessment of medical waste generated at households was not made in Belarus. Currently, this problem is not considered as relevant by governmental agencies.

### Waste oil.

Management of petrochemicals industrial waste is well developed. At present, almost 90 % of the collected waste oil is utilized as fuel or used in plants. The waste is burnt in boiler-houses and others facilities for heating and energy production. Several plants process oil-based waste to produce on its base fuel. According to the [National Statistical Committee](#), 2500 tons of waste oil was collected in 2013. The State Association "Belarusian Railway" is engaged in processing of waste oil, oil slime, oil-water mixture forming during rail transits. The plant capacity is 9500 m<sup>3</sup> per year for oil-water mixture and 1700 m<sup>3</sup> per year for oil slime (Survey..., 2016).

Utilization of ferrous and non-ferrous metals is fulfilled separately from the municipal waste. These metals are collected by the metal waste purchasing network which is subordinated by the SU "Belvtormet". In 2013 the enterprise produced 773 ths t of ferrous metal and 15 400 t of non-ferrous metal. 86,6 % of the collected scrap of ferrous metal is the scrap of steel, and the biggest part of the collected scrap non-ferrous metal is a scrap of aluminum (50,6 %). The collected metals are used for producing of different goods at enterprises under the command of SU "Belvtormet" or sold by the Belarusian Universal Commodity Exchange (Survey..., 2016).

In Mogilev region the main recycling plants are

- waste paper - Paper factory "Spartak" (Shklov);
- plastic waste - "RePlas-M" (Mogilev), "Recycling plant" (Mogilev), SAE (Mogilev);
- glass waste – Glass factory "Elizovo" (Osipovich district);
- used tires – "Danoton" (Mogilev), "Krichev cementnoshifer" (Krichev) and "Belarusian Cement Plant" (Kostyukovich);
- scrap ferrous metals – "Vtrochermet";
- scrap of non-ferrous metals – "Beltsvetmet";
- batteries and WEEE – "Bel VTI".

In 2012, paper factory "Spartak" recycled 35 ths t of waste paper, and the Glass factory "Elizovo"- 9,8 ths t of glass waste.

Technologies for the extraction of "landfill gas" was started to implement at MSW landfills in Belarus. Produced landfill gas is used for burning and electric power generation. In 2013 were introduced into operation 5 facilities at landfills in Vitebsk (capacity 1 megawatt), Orsha (capacity 0,2 megawatt), Gomel (capacity 1,3 megawatt), Minsk (capacity 2 megawatt and 2,8 megawatt) ([Concept of WM of MSW](#)).

In general, in 2013 the collection of traditional recycling materials (paper, glass, plastic, textile, used tires) was 454,1 ths t, or about 12 % from total amount of generated MSW. HPU organizations collected about 20 % of recycling materials. The amount of collected SRM (including paper, glass, plastic, textile, rubber, construction waste) increased in 5 times in compare with 2008 (Fig. 1.3.5). The amount of paper waste increased 2,2 times and was 22 ths t. The amount of glass waste increased 4,3 times (figure 46: Collection of recyclables in Belarus figure 46).

Indicators of regional program for recyclables collection in Mogilev region in 2015 were conducted (based on [Report of RD of MHPU](#)):

- paper and cardboard - on 71,1 % (36893,4 tons of tasked 51900,0),
- glass - on 103,3 % (19624,9 tons of tasked 19000,0),
- polymers - on 108,0 % (7884,8 tons of tasked 7300),
- textile - on 79,4 % (953,2 tons of tasked 1200,0),
- used tires - on 102,5 % (9536,8 tons of tasked 9300,0);
- construction waste - on 100,6 % (17000,1 tons of tasked 17000,0).

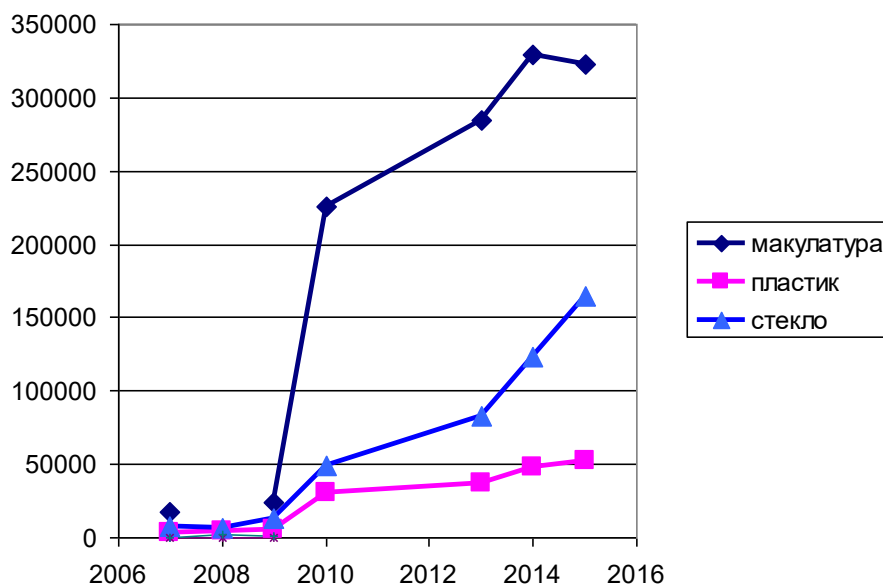


figure 46: Collection of recyclables in Belarus

### Landfilling

Relatively low capital costs of landfill construction in compare to other waste disposal methods led to the fact that landfilling is the most common practice of MSW treatment. Landfilling includes two steps: (1) accumulation of mixed MSW at temporary storage sites, mainly in containers, and (2) transportation to landfills on a regular basis or removal of waste upon requests of enterprises and individuals. Waste transported to landfills is leveled, compressed layer-by-layer and insulated with inert material. Until recently, waste was dumped close to places where it was generated, including uncontrolled dumps. Industrial waste, similar to MSW, generated in organizations and plants, as well as industrial waste of non-dangerous and 4 class of danger are also landfilled. The share of such kind of industrial waste is about 30-35 %. Especially large part of industrial waste is landfilled at dumps of MSW near large cities. In addition, municipal, industrial and hazardous waste are landfilled together, creating dangerous toxic conditions.

According to ([Concept of WM of MSW](#)), in 2013 there were 164 landfills and 2755 mini-dumps in Belarus. The trend is to close small facilities. The total area of landfills is about 3 000 ha. Over 40 % of the landfills have exhausted their operating capacity.

Engineering and geological surveys were not carried out at most dumps constructed before 1991, so the owners of the objects do not have information about the hydrogeological characteristics of the landfill area. The passports of the wells, if they have been

made, are often missed, and therefore data on geological and lithological composition is lost. Sand and sandy loam with high filtration properties are at the base of many of wells. 74 % of the landfills have a network of the monitoring of groundwater, which usually consists of 2-5 wells. Average well depth varies from 4 to 10 m, rarely reaching 15-25 m. Local groundwater monitoring is carried out at 112 landfills of MSW. The monitoring of surface water, soil and air at the waste facilities impact area is carried out episodically, unsystematically (Lysuho&Eroshina, 2011).

Landfills do not meet sanitary rules, such as using liners and collection systems for leachate. 112 of the 164 landfills have protective insulating screens, 91 landfills have weighing equipment. Before the stopping of many legal and illegal disposal sites, they are needed in the rehabilitation in order to protect the environment and humans' health.

Currently, 21 city landfills, 243 MSW mini-landfills and 258 temporary waste storage site are in operation in Mogilev region. Improvement of existing landfills and reclamation of closed mini-landfills are carried out in the region annually. In 2012 landfills in Mogilev region have received 300 ths t of municipal waste. Waste composition consists of the SRM up to 60 %: paper and cardboard, glass, plastics, metals, textiles, leather, rubber, household appliances and other wastes, including hazardous wastes.

### 11.2.3 Legal and economic instruments to support waste management hierarchy

#### **Before 1990**

Regulations on processing MSW in Belarus include established "norms" of waste generation. They are calculated on the base of material and source balance of production process. The waste disposal "norms" are calculated on the basis of the portion of the SRM in the total value of generated waste. On the one hand, this method establishes the basic level for control over plants, but, on the other hand this can influence the decision of the waste producer to give in reports the "desired" data in accordance with approved figures (Survey..., 2016). "Norms" are approved by local and regional executive bodies.

Financial instruments are set to achieve the full recovery of MSW management costs. The plants engaged in the waste collection and removal in every region have to calculate and report the collection, removal and disposal costs on the base of the prime costs compared with the reduced tariff (real cost for population). Data analysis is allowed to

compare the tax for the waste collection and removal in the different regions and to estimate the governmental subsidies (Survey..., 2016).

The tariffs for MSW removal and treatment do not correspond to the real economic costs and do not include the cost of the development of new technological processes (separate collection, recycling). Cross-subsidization of tariff regulation (i.e, when the tariffs on the MSW removal and disposal for legal entities are much higher than for the population) is used for the de-monopolization of this sphere. But in practice, in some cities it has led to lobbying and attraction of the companies specializing in providing services for the removal of MSW only for legal entities. Financial resources, obtained by higher tariffs for legal entities and previously used to finance the system of MSW collection and removal from the residential sector, now are redistributed in favor of certain private companies. These companies are not burdened with the organization of the system of MSW separate collection in the residential sector and are almost free in using of it for their own commercial purposes for providing MSW removal services only for legal entities.

Under the President's Decree № 313 "On Some Issues of Consumer Waste Disposal", the procedure for implementation of EPR is established; and the list of goods coming within the purview of the law are constituted as well as amount of consumption waste and recycle package. Retailers have to make room for collection of the secondary resources and packages at their area. The level of the secondary resource collection in 2015 is 15%, in 2017 – 20% and in 2020 – 30%, Package collection level in 2015 is 35%, in 2017 - 40% and in 2020 – 50%. There are no reports on achieving these indicators. The order of the Council of Ministers № 708 of 2012 amends the President's decree № 313 and establishes the payment should be made by suppliers and producers of goods lost their consumer properties, as well as for the organization of collection of waste and package.

### **After 1990**

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#### 11.2.4 Waste management system financing

##### Before 1990

Soviet Union is an example of a centralized and planned economy that directly concerns all spheres of economic activities including MSW management and recycling. In 1969 the planned pricing in the USSR has been became a separate area of governance. State Committee of prices of Council of Ministers in the USSR was established. State Committee of prices was in charge for pricing policy, for organization and operation status of prices in the USSR, as well as for the validity of the approved prices and tariffs.

The financing system was operated by follow way. State established tariffs for the removal and treatment of municipal waste for all settlements in the country. Cross-subsidization was widely spread approach in municipal services. Tariffs for the population were much less than for legal entities. Tariffs for the population did not cover all costs of municipal services; the difference was subsidized from the state budget or at the expenses of legal entities. Tariffs for the population were maintained unchanged for the long time at the minimal level throughout the Soviet period.

All investments came from state budget, there was no private business.

There is no available data on tariffs for the population end legal entities used in BSSR.

##### After 1990

The tariff policy in the field of public services is approved by President in its entirety. President of the Republic of Belarus (1) sets up state bodies and organizations establishing and regulating the public services pricing; (2) approves the procedure of calculating of the public services pricing. President's decree from 25.02.11 № 72 "About some questions of price regulation (rates) in Republic of Belarus" approves that regional executive committees and Minsk Cite Executive Committee controls prices (tariffs) for: the removal and treatment of MSW; the service of removal of the wastes generated in the garden cooperatives.

President's decree from 06.10.2006 № 604 "About measures for increase of overall performance of housing and communal services" (Decree № 604). According to a.1,9 of Decree, pricing for public services (MSW removal and treatment) has to be set in the view

of the population incomes. Decree № 604 establishes that the expenditures on the MSW removal and treatment services are partly compensated by removal and treatment tariffs for legal entities. Regional executive committees and Minsk City Executive Committee set up tariffs in view of possibility of partial compensation of the services costs for population. In addition, the Decree № 604 establishes that the public services costs are not compensated by legal entities should be compensated by regional budgets and Minsk city budget. Legal entities pay almost three times more than population. This gap slightly narrowed in 2009 (Document of the World Bank, 2010). According to the data of 2015, the received money for MSW collection, removal and storage from population covered about 85% of costs.

According to p.47 of the Instruction №13 the calculation of the payment for MSW collection, removal and treatment is fulfilled on the basis of the “norms” of MSW generation per one person and is approved by the local executive authority. So, the consumer (population) payment for MSW removal and treatment is not based on the real quantity of the services (real waste quantity removed to the landfill), but on the basis of the MSW generation “norms”. Current Belarusian legislation allows covering all costs for removal and treatment of MSW only in 2 ways: (1) by increasing the tariffs for removal and landfilling; or (2) increasing “norms” of MSW generation per person.

The removal and landfill tariffs in Belarus do not distinguish the payment for these two components. This is not a problem if, as it usually occurs in Belarus, the removal and landfill services are rendered by the same organization. Nevertheless, in Minsk where these two activities are separated, the company running the waste landfilling has to subsidize the landfill at the expense of the income from the waste sorting and others activities (Survey..., 2016).

To keep the course of improvement of the financing MSW management it is necessary:

- ➔ to set up tariffs for different operations with consumption waste;
- ➔ to realize the possibilities to pay for waste serves on the basis of the real amount of waste; and at the same time include on occasion the calculation of the service payment according to “norms”;
- ➔ to sign agreements with the population on extended services on the waste management, in particular on collection of SRM, transportation and sorting bulky waste (Gnedov, 2012);

- ➔ to cut cross-subsidization: to re-arrange tariff policy, to establish and enforce new economic instruments for calculation of fees for MSW collection, removal, treatment and disposal.

### 11.2.5 Public awareness, education and communication initiatives

#### **Before 1990**

The social motivation of the population was the base for the SRM collection in the USSR. On the one hand cultural behavioral patterns were formed; on the other hand, the importance of the recycling was promoted (Recycling materials, 2015).

Mentioned above action "Imaginative literature in exchange on waste paper" had impressive effect on Soviet people. In addition to this action special interventions were carried out for involving youth in recyclables collection. Since 1974 and until the USSR collapse all-Union competition for Young Pioneer and Komsomol organizations on collection of paper was held. The motto of action was "Million to Motherland!" Action had significant educational value (Zakharov et al., 1980). After the starting of all-Union competition paper collection by schoolchildren increased by more than 2 times (before competition annually collected 80-95 ths t, during competition – 177-197 ths t) and achieved 8-9 % from total paper collection in the USSR (Zalkind et al., 1985).

Huge attention was given to the reporting about all-Union competition and promotion of the waste paper collection. Mass-media was involved into distribution of information: newspaper "Komsomolsky projector"; the broadcast "Pionersky signal" and etc. In addition, excursions to the paper plants and print shops for schoolchildren were organized; residents were informed through performances before the parents in the school, conversations of the schoolchildren with tenants and so on.

#### **After 1990**

The soviet system of propaganda of resource saving, recycling and separate waste collection is completely lost. At present, several initiatives are realized in Belarus mainly by social organizations with the financial support of international fund organizations and volunteers.

**Development of the e-resource "Green map".** «Green map» (<http://greenmap.by/o-proekte>, n.d.) – is the web-page collected information about environmentally significant objects: collecting points for waste and recyclables; organizations which are in charge for environmental protection; renewable energy sites; unique natural sites and etc. «Green map» is a public project implemented by Center of environmental solutions with support of international project «Facilitating the transition of the Republic of Belarus to the "green" economy», financed by EU and UNDP program. Project «Green map» is developing with help of volunteers who check, update data and answer the user comments.

**Target 99** (<http://www.target99.by/>, n.d.) is a project implemented by Operator of recyclables. At the same time on the official project web-page Target 99 is described as a "civil movement, open for everybody who wants to join". The project aim is to sort and treat 99 % of MSW. Official explanation "why 99, not 100 %" sounds as "99 % is a symbol of our attempt to get maximum with understanding that there is no full perfection. Not only result is an important, but moving to the right direction". Under Target 99 there are a lot of information materials were developed (posters, video clips, booklets and etc.). Target 99 organizes special competitions for schoolchildren in collection of recyclables.

**Let do it ! (Зробім!)** (<http://www.letsdoit.by/>, n.d.). Belarus joined to world action Let's Do It! Cleanups under «Let`s Do It!» initiative were started in 2012 in Belarus. In 2015 about 1500 people participated in actions around Belarus, they organized 60 cleanups and collected 122 tons of waste. The executive committee of the movement consists of representatives of governmental and non-governmental organizations engaged in environmental protection and sustainable development: Center of environmental solution, Green network, foundation "Interaction", NGO "Minsk Cycling Community", MNREP, MHPU. But the main persons in action are volunteers. The movement became popular in contrast to obligatory "Subbotniks". A number of active volunteers continue the action during the whole year.

Belarus took part in the EU project "Waste management -- European neighborhood and partnership instrument: the East region" in 2009- 2013 with the total budget of 5,8 million euro. During this project Pukhovichskiy raion was chosen as a pilot district for inventory of the landfills, development of new strategy on WM and designing of modern landfill.

The EBRD deals with the problem of financing of the regional landfill construction according to the EU standards and equipped it with a sorting line, the waste composting facility, and also with transport and equipment for improvement of the waste collection and removal process from the Pukhovichskiy and Chervenskiy districts (Survey..., 2016).

During 2011-2014 the project "Promoting the development of a comprehensive framework for international cooperation in the field of environmental protection in the Republic of Belarus" was implemented with support of EU and UNDP (project budget is 5 159 469 euro). National and international experts made suggestions on improving legislation in the field of environmental protection, waste management, biodiversity conservation, water management, as well as environmental certification (Survey..., 2016).

One of the example of public initiative is a pilot project on the MSW management in towns Kobrin and Mosty. More information about project could found in the report, see (Bendere, 2013).

The World Bank granted a loan of 42,5 million \$ for the implementation of the "Municipal Solid Waste management in the Republic of Belarus". The project is supported designing, construction and control of building of new sorting plant with total capacity 120 t/yr in Grodno, as well as improvement of MSW separate collection (Document of the World Bank, 2010).

#### 11.2.6 Barriers and success factors for waste management performance

##### **Before 1990**

In regards to the Soviet system of MSW management the following strengths and weaknesses (Table 21) can be identified.

Table 21: Strengths and weakness of Soviet WM systems

<i>Strengths</i>	<i>Weakness</i>
Propaganda, powerful information support of governmental decisions	Lack of an attention to the problem of waste, the lack of sound policy in this area
Trust and support of government by the public	Lack of environmental legislation
Huge resource, research and development, production and technical, administrative capacity	Institutional fragmentation and overlapping of powers
Huge area with different conditions	The rigid centralized and planned economy, the absence / lack of foreign investment, the lack of private business

**After 1990**

The existing barriers of MSW management in Belarus are:

1. For the population the current tariff level for housing and municipal services on the removal, recycling and burial of MSW and prices on SRM does not cover the cost of a full management cycle of MSW (collection, removal, sorting, recycling, neutralization and burial of MSW), and it is doesn't allow to attract investment to build facilities for sorting and recycling of MSW and to develop a competitive environment of MSW management.
2. The system of MSW separate collection requires further development and investment to create the necessary infrastructure. It also requires an information work with the population. Low level of the environmental culture leads to blockage of the system of separate waste collection. Education and awareness of the population have to be considered as a crucial point in the MSW management. It is necessary to develop and strengthen existing communication initiatives.

3. Many of the technological concepts for the MSW management are approved without the development of the regional (city) programs for the MSW management and their connection with the existing system of collection and burial of MSW and regional specific conditions.
4. In order to implement the principle of «if you litter – you pay» the current legislation requires detailing and making the new approaches to formation of the tariff policy.
5. Lack of the institutional mechanisms for the collection of some types of waste from the population: hazardous wastes (mercury-containing waste, medical waste, electronic waste), automobile wastes and some other.
6. Short list of waste collected from the population separately. Settlements must have the special centers of waste collection where citizens can deliver generated waste (cardboard, paper, plastic, paint tins, batteries, building material, home appliances and so on ) by themselves.
7. Limited demand on recyclables. To stimulate the use of waste for receiving recyclables and energy Belarus should prohibit landfilling, and existing mini-landfills should be enlarged or liquidated. At the same time, the soviet instruments and mechanisms stimulating the collection of recyclable should be used, for example, involving retail companies, social organizations, as well as implementation of the principle of EPR.
8. Complicate system of waste governance. At present 6 Ministries are in charge for WM.
9. At present, HPU organizations are in charge for MSW management. They are responsible simultaneously for long list of other municipal services, mainly unprofitable. Special organizations should be established for MSW collection and treatment. In this case the room to improve MSW management will be created.
10. Licensing in the field of recycling and MSW management limits the private initiatives. Private companies could develop improved system of MSW management due to their mobility and attract international investments.
11. It is necessary to implement special programs on Eco-labeling and Eco-design.



The success factors are included in the Concept of WM of MSW which assumes:

1. To develop the logistical basis of collection (provision), transport and use of SRM; to increase the number of standardized containers for separate collection of MSW and equipment for their maintenance; to design new apartment houses without garbage chutes; to close the existing garbage chutes and to build the container platforms for the separate collection of MSW.
2. To expand the network of receiving and storage centers for SRM, including the organization of SRM collection based on trading facilities.
3. To establish the centers for separate waste collection (to organize special sites for the population, equipped with containers for waste delivery and sorting by waste types free of charge).
4. To develop the own waste collection systems by manufacturers and suppliers of goods and package as a part of the principle of EPR.
5. To carry out reconstruction, modernization, and renovation of existing facilities for sorting and preparing to use of SRM.
6. To construct of new plants for the recycling of SRM in view of their economic efficiency, to expand the range of the recycled SRM and goods made from recyclables.
7. To improve the legislation of MSW management and SRM management and to unify it within the participation of the Republic of Belarus in the EurAsEC: to improve the mechanisms of stimulation and involvement of the population in separate collection of MSW and storage of SRM including tariff regulation; to develop legislation on the deposit system of treatment of certain container types; to improve the mechanisms of economic incentives for entrepreneurial activity in the collection and use of SRM.
8. To improve the tariff policy.
9. To attract investments in facilities of MSW sorting and recycling.
10. To develop a competitive environment in MSW collection and removal, to carry out the implementation of public-private partnership mechanisms.

## 12. Overview of waste management in Russia

### 12.1 Overall Background

Founded in the 12th century, the Principality of Muscovy, was able to emerge from over 200 years of Mongol domination (13th-15th centuries) and to gradually conquer and absorb surrounding principalities. In the early 17th century, a new ROMANOV Dynasty continued this policy of expansion across Siberia to the Pacific. Under PETER I (ruled 1682-1725), hegemony was extended to the Baltic Sea and the country was renamed the Russian Empire. During the 19th century, more territorial acquisitions were made in Europe and Asia. Defeat in the Russo-Japanese War of 1904-05 contributed to the Revolution of 1905, which resulted in the formation of a parliament and other reforms. Repeated devastating defeats of the Russian army in World War I led to widespread rioting in the major cities of the Russian Empire and to the overthrow in 1917 of the imperial household. The communists under Vladimir LENIN seized power soon after and formed the USSR. The brutal rule of Iosif STALIN (1928-53) strengthened communist rule and Russian dominance of the Soviet Union at a cost of tens of millions of lives. The Soviet economy and society stagnated in the following decades until General Secretary Mikhail GORBACHEV (1985-91) introduced glasnost (openness) and perestroika (restructuring) in an attempt to modernize communism, but his initiatives inadvertently released forces that by December 1991 splintered the USSR into Russia and 14 other independent republics. Since then, Russia has shifted its post-Soviet democratic ambitions in favor of a centralized semi-authoritarian state in which the leadership seeks to legitimize its rule through managed national elections, populist appeals by President PUTIN, and continued economic growth.

*Russian Soviet Federative Socialist Republic is the world's first socialist state. It was proclaimed as a result of the October Revolution in Russia in 1917. Since the formation in 1922 of the Union of Soviet Socialist Republics to 1991 is a sovereign union republic within the Soviet Union. RSFSR was the largest Soviet republic in size, population and economic power. It occupied three quarters of the USSR's territory; had more than half of the population, produced two-thirds of industrial and a half of agricultural production of the Soviet Union. After the demise of the USSR on 26<sup>th</sup> December 1991 RSFSR became the successor of the USSR. Since December 25<sup>th</sup>, 1991 RSFSR had the modern name (Russian Federation - Russia). After the formation of the Soviet Union, the economy of the RSFSR became an integral part of the Soviet*

*economy. In essence, economic structure of modern Russia was founded in the 1950s. Soviet Union began to establish a base for the resource-based economy in the late 1950s, and in 1960s had an aim to achieve the status of an energy super-power state. Available demographic, social and economic indicators of the RSFSR are shown in Table 22.*

Table 22: Social and economic indicators of RSFSR 1990

Index	1980	1985	1986	1987	1988	1989	1990
Popula- tion, ths. per					147400	148041	148543
Birth rate per 1000	15,9	16,6	17,2	17,2	16,0	14,6	13,4
Death rate per 1000	11,0	11,3	10,4	10,5	10,7	10,7	11,2
Natural popula- tion growth per 1000	4,9	5,3	6,8	6,7	5,3	3,9	2,2
Infant mortality per 1000	22,1	20,7	19,3	19,4	18,9	17,8	17,4
Life ex- pectancy at birth	67,6	68,1	69,3	70,1	69,9	69,6	69,3
The aver- age monthly incomes, rub	177,7	201,4	207,8	216,1	235,2	258,6	296,8
Improved urban wa- ter sup- ply, %	90	92	92	93	93	93	94
Improved urban sewerage, %	88	90	90	91	91	91	92
Number of schools	17638	18574	19014	19335	19581	19897	20328
Number of school- children, mln per	17,6	18,6	19,0	19,3	19,6	19,9	20,3

Number of doctors per 10000	40	45	46	46	47	47	47
Number of hospital beds per 10000	130	135	135	136	137	139	138
Total volume of industrial output (at constant prices), bn. rub	411	484	506	523	543	551	550
Loss-making enterprises,% Industry Agriculture Construction				13,1 18,8 10,7	9,7 2,1 5,4	6,1 1,6 4,7	7,0 2,8 7,2
Agricultural production (in comparable prices), bn rub.	184,3	208,4	217,7	220,0	228,8	236,5	234,4
Retail turnover, bn rub	158,1	188,2	191,5	196,6	2106	232,7	269,5
Export, mln.rub					45100	47100	41600
Import, mln.rub					43900	49200	47800

Effective management of MSW in Russia is becoming a crucial point in the governance today. The main drivers of the development of regional waste management sector are:

- current running state of the industry (no licensed landfills, the minimum share of recycled MSW, etc.);
- significant dominance of amount of generated waste on the opportunities of their treatment and utilization.

The most impressive illustration of the first driver is the situation in Republic Karelia, where is generated and stored about 400 ths t per year of MSW without licensed landfills at all. Example of the second driver is the situation in Moscow region. 4,5 mln t per year of MSW is generated in Moscow region; MSW is landfilled at 40 licensed dumps, but most of them are full and either have been closed or should be closed in next few years (Economic aspects..., 2015).

### 12.1.1 Country profile

Table 23: General information about Russia (web-site Index Mundi, n.d.)

Location	North Asia bordering the Arctic Ocean, extending from Europe (the portion west of the Urals) to the North Pacific Ocean
Area	total: 17098242 km <sup>2</sup> land: 16377742 km <sup>2</sup> water: 720500 km <sup>2</sup>
Land boundaries	total: 22407 km border countries: Azerbaijan 338 km, Belarus 1312 km, China (southeast) 4133 km, China (south) 46 km, Estonia 324 km, Finland 1309 km, Georgia 894 km, Kazakhstan 7644 km, North Korea 18 km, Latvia 332 km, Lithuania (Kaliningrad Oblast) 261 km, Mongolia 3452 km, Norway 191 km, Poland (Kaliningrad Oblast) 209 km, Ukraine 1944 km
Coast line	37653 km
Maritime claims	territorial sea: 12 nm contiguous zone: 24 nm exclusive economic zone: 200 nm continental shelf: 200 m depth or to the depth of exploitation
Climate	ranges from steppes in the south through humid continental in much of European Russia; subarctic in Siberia to tundra climate in the polar north; winters vary from cool along Black Sea coast to frigid in Siberia; summers vary from warm in the steppes to cool along Arctic coast
Terrain	broad plain with low hills west of Urals; vast coniferous forest and tundra in Siberia; uplands and mountains along southern border regions
Elevation extremes	lowest point: Caspian Sea -28 m highest point: Gora El'brus 5633 m (highest point in Europe)
Natural resources	wide natural resource base including major deposits of oil, natural gas, coal, and many strategic minerals, reserves of rare earth elements, timber note: formidable obstacles of climate, terrain, and distance hinder exploitation of natural resources

Land use	arable land: 7,11% permanent crops: 0,1% other: 92,79% (2011)
Irrigated land	43460 km <sup>2</sup> (2008)
Total renewable water resources	4508 km <sup>3</sup> (2011)
Freshwater withdrawal (domestic/industrial/agricultural)	total: 66,2 km <sup>3</sup> /yr (20%/60%/20%) per capita: 454,9 m <sup>3</sup> /yr (2001)
Environment - current issues	air pollution from heavy industry, emissions of coal-fired electric plants, and transportation in major cities; industrial, municipal, and agricultural pollution of inland waterways and seacoasts; deforestation; soil erosion; soil contamination from improper application of agricultural chemicals; scattered areas of sometimes intense radioactive contamination; groundwater contamination from toxic waste; urban solid waste management; abandoned stocks of obsolete pesticides

### 12.1.2 Development of economic and environmental situation

Table 24: Demographic and medical profile of Russia (web-site Index Mundi, n.d.)

Population	142470272 (July 2014 est.)
Age structure	0-14 years: 16,4% (male 11980138/female 11344818) 15-24 years: 10,7% (male 7828947/female 7482143) 25-54 years: 45,8% (male 31928886/female 33319671) 55-64 years: 13,8% (male 8408637/female 11287153) 65 years and over: 13,3% (male 5783983/female 13105896) (2014 est.)
Median age	total: 38,9 years male: 36 years female: 41,9 years (2014 est.)
Life expectancy at birth	total population: 70,16 years male: 64,37 years female: 76,3 years (2014 est.)
Population growth rate	-0,03% (2014 est.)
Birth rate	11,87 births/1,000 population (2014 est.)
Death rate	13,83 deaths/1,000 population (2014 est.)
Infant mortality rate	total: 7,08 deaths/1000 live births male: 7,93 deaths/1000 live births female: 6,18 deaths/1000 live births (2014 est.)
Net migration rate	1,69 migrant(s)/1000 population (2014 est.)
Urbanization	urban population: 73,8% of total population (2011) rate of urbanization: 0,13% annual rate of change (2010-15 est.)
Mother's mean age at first birth	24,6 (2009 est.)
Total fertility rate	1,61 children born/woman (2014 est.)

Ethnic groups	Russian 77,7%, Tatar 3,7%, Ukrainian 1,4%, Bashkir 1,1%, Chuvash 1%, Chechen 1%, other 10,2%, unspecified 3,9% note: more than 190 ethnic groups are represents in Russia's 2010 census (2010 est.)
Religions	Russian Orthodox 15-20%, Muslim 10-15%, other Christian 2% (2006 est.) note: estimates are of practicing worshipers; Russia has large populations of non-practicing believers and non-believers, a legacy of over seven decades of Soviet rule
Languages	Russian (official) 96,3%, Dolgang 5,3%, German 1,5%, Chechen 1%, Tatar 3%, other 10,3% note: shares sum to more than 100% because some respondents gave more than one answer on the census (2010 est.)
Literacy	total population: 99,7% male: 99,7% female: 99,6% (2010 est.)
School life expectancy (primary to tertiary education)	14 years
Education expenditures	4,1% of GDP (2008)
Health expenditures	6,2% of GDP (2011)
Physicians density	4,31 physicians/1000 population (2006)
Hospital bed density	9,7 beds/1000 population (2006)
Obesity - adult prevalence rate	26,5% (2008)
Drinking water source	improved: urban: 98,7% of population rural: 92,2% of population total: 97% of population unimproved: urban: 1,3% of population rural: 7,8% of population total: 3% of population (2012 est.)
Sanitation facility access	improved: urban: 74,4% of population rural: 59,3% of population total: 70,5% of population unimproved: urban: 25,6% of population rural: 40,7% of population total: 29,5% of population (2012 est.)

### Economic situation:

Russia has undergone significant changes since the collapse of the Soviet Union, moving from a globally-isolated, centrally-planned economy towards a more market-based and globally-integrated economy, but stalling as a partially reformed, stat-

ist economy with a high concentration of wealth in officials' hands. Economic reforms in the 1990s privatized most industry, with notable exceptions in the energy and defense-related sectors. The protection of property rights is still weak and the private sector remains subject to heavy state interference. Russia is one of the world's leading producers of oil and natural gas and is also a top exporter of metals such as steel and primary aluminum. Russia's manufacturing sector is generally uncompetitive on world markets and is geared toward domestic consumption. Russia's reliance on commodity exports makes it vulnerable to boom and bust cycles that follow the volatile swings in global prices. The economy, which had averaged 7 % growth during 1998-2008 as oil prices rose rapidly, was one of the hardest hit by the 2008-09 global economic crisis as oil prices plummeted and the foreign credits that Russian banks and firms relied on dried up. Slowly declining oil prices over the past few years and difficulty attracting foreign direct investment have contributed to a noticeable slowdown in GDP growth rates. In late 2013, the Russian Economic Development Ministry reduced its growth forecast through 2030 to an average of only 2,5 % per year, down from its previous forecast of 4,0 to 4,2 %. Some economic data is represented in the Table 25.

Table 25: Economic situation in Russia (web-site Index Mundi, n.d.)

GDP (purchasing power parity)	\$2,553 trillion (2013 est.) \$2,52 trillion (2012 est.) \$2,437 trillion (2011 est.) note: data are in 2013 US dollars
GDP (official exchange rate)	\$2,113 trillion (2013 est.)
GDP - real growth rate	1,3% (2013 est.) 3,4% (2012 est.) 4,3% (2011 est.)
GDP - per capita (PPP)	\$18100 (2013 est.) \$17800 (2012 est.) \$17100 (2011 est.) note: data are in 2013 US dollars
Gross national saving	28,3% of GDP (2013 est.) 29,5% of GDP (2012 est.) 30,6% of GDP (2011 est.)
GDP - composition, by end use	household consumption: 51,3% government consumption: 18,8% investment in fixed capital: 22% investment in inventories: 1,4% exports of goods and services: 29,6% imports of goods and services: -23% (2013 est.)



GDP - composition by sector	agriculture: 4,2% industry: 37,5% services: 58,3% (2013 est.)
Population below poverty line	11% (2013 est.)
Labor force	75,29 million (2013 est.)
Labor force - by occupation	agriculture: 9,7% industry: 27,8% services: 62,5% (2012)
Unemployment rate	5,8% (2013 est.) 5,5% (2012 est.)
Unemployment, youth ages 15-24	total: 14,8% male: 14,5% female: 15,1% (2012)
Household income or consumption by percentage share	lowest 10%: 5,7% highest 10%: 42,4% (2011 est.)
Distribution of family income - Gini index	42 (2012) 41,7 (2011)
Budget	revenues: \$439 billion expenditures: \$450,3 billion (2013 est.)
Taxes and other revenues	20,7% of GDP (2013 est.)
Budget surplus (+) or deficit (-)	-0,5% of GDP (2013 est.)
Public debt	7,9% of GDP (2013 est.) 8% of GDP (2012 est.) note: data cover general government debt, and includes debt instruments issued (or owned) by government entities other than the treasury; the data include treasury debt held by foreign entities; the data include debt issued by subnational entities, as well as intra-governmental debt; intra-governmental debt consists of treasury borrowings from surpluses in the social funds, such as for retirement, medical care, and unemployment, debt instruments for the social funds are not sold at public auctions
Inflation rate (consumer prices)	6,8% (2013 est.) 5,1% (2012 est.)
Central bank discount rate	8,25% (31 December 2012 est.) 8% (31 December 2011) note: this is the so-called refinancing rate, but in Russia banks do not get refinancing at this rate; this is a reference rate used primarily for fiscal purposes
Commercial bank prime lending rate	9,3% (31 December 2013 est.) 9,1% (31 December 2012 est.)
Stock of narrow money	\$452,8 billion (31 December 2012 est.) \$399,3 billion (31 December 2011 est.)
Stock of broad money	\$1,061 trillion (31 December 2012 est.) \$893,1 billion (31 December 2011 est.)
Stock of domestic credit	\$947 billion (31 December 2013 est.)

	\$922,6 billion (31 December 2012 est.)
Agriculture - products	grain, sugar beets, sunflower seeds, vegetables, fruits; beef, milk
Industries - products	complete range of mining and extractive industries producing coal, oil, gas, chemicals, and metals; all forms of machine building from rolling mills to high-performance aircraft and space vehicles; defense industries (including radar, missile production, advanced electronic components), shipbuilding; road and rail transportation equipment; communications equipment; agricultural machinery, tractors, and construction equipment; electric power generating and transmitting equipment; medical and scientific instruments; consumer durables, textiles, foodstuffs, handicrafts
Industrial production growth rate	0,1% (2013 est.)
Current Account Balance	\$74,8 billion (2012 est.) \$71,43 billion (2012 est.)
Exports	\$515 billion (2013 est.) \$528 billion (2012 est.)
Exports - commodities	petroleum and petroleum products, natural gas, metals, wood and wood products, chemicals, and a wide variety of civilian and military manufactures
Exports - partners	Netherlands 14,6%, China 6,8%, Germany 6,8%, Italy 6,2%, Turkey 5,2%, Ukraine 5,2%, Belarus 4,7% (2012 est.)
Imports	\$341 billion (2013 est.) \$335,7 billion (2012 est.)
Imports - commodities	machinery, vehicles, pharmaceutical products, plastic, semi-finished metal products, meat, fruits and nuts, optical and medical instruments, iron, steel
Imports - partners	China 16,6%, Germany 12,2%, Ukraine 5,7%, Japan 5%, United States 4,9%, France 4,4%, Italy 4,3% (2012 est.)
Reserves of foreign exchange and gold	\$515,6 billion (01 December 2013 est.) \$537,6 billion (31 December 2012 est.)
Debt - external	\$714,2 billion (30 September 2013 est.) \$636,4 billion (31 December 2012 est.)
Stock of direct foreign investment - at home	\$552,8 billion (31 December 2013 est.) \$497,8 billion (31 December 2012 est.)
Stock of direct foreign investment - abroad	\$439,2 billion (31 December 2013 est.) \$387,2 billion (31 December 2012 est.)

Environmental situation:

Environmental footprint of Belarus is briefly represented in Table 26.

Table 26: Environmental footprint of Russia

Year	Carbon dioxide emissions (CO <sub>2</sub> ), kg CO <sub>2</sub> per \$1 GDP (UN-FCCC)	Carbon dioxide emissions (CO <sub>2</sub> ), metric tons of CO <sub>2</sub> per capita (UN-FCCC)	Carbon dioxide emissions (CO <sub>2</sub> ), thousand metric tons of CO <sub>2</sub> (UN-FCCC)	Consumption of all Ozone-Depleting Substances in ODP metric tons	Energy use (kg oil equivalent) per \$1,000 GDP	Terrestrial and marine areas protected to total territorial area, %	Terrestrial and marine areas protected, sq. km.
1990	1,34	16,9	2499718,6	130578,5	470	4,78	869621
1991	1,32	15,8	2349401,9	51714,5	490	4,95	900359
1992	1,27	13	1928230,9	48929,8	524	5,12	931265
1993	1,32	12,3	1831482,6	29777,6	541	5,86	1066081
1994	1,34	10,9	1619847,6	25885,1	541	6,69	1215801
1995	1,35	10,6	1571040,3	23641,3	547	7,86	1429045
1996	1,37	10,3	1531990,9	13995,1	562	8,78	1597494
1997	1,28	9,8	1456752,3	12051,7	530	8,91	1619642
1998	1,33	9,7	1432790	12503,3	546	9,05	1645536
1999	1,28	10	1469818,4	15353,9	532	9,08	1650935
2000	1,17	10	1471392,8	25744,1	491	9,09	1652333
2001	1,13	10,2	1490664,6	761,5	473	9,11	1656577
2002	1,08	10,3	1491534,1	892,3	449	9,19	1671612
2003	1,02	10,5	1521447,9	938,4	434	9,19	1671897
2004	0,96	10,6	1524278,9	1105,2	406	9,19	1671898
2005	0,9	10,7	1526102,2	776,1	384	9,19	1671898
2006	0,86	11,1	1583034,7	1189,5	365	9,19	1671899
2007	0,79	11,1	1580249,3	1391,3	338	9,19	1671899

2008	0,77	11,4	1615116,8	1457,6	328	9,19	1671899
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## 12.2 Waste management situation in Russia

### 12.2.1 Legal and institutional framework of waste management

The main legislative instruments in the field of solid waste management in the USSR are provided in section 11.2.1 Legal and institutional framework of waste management. In addition to those documents the follow regulations were adopted in RSFSR:

- ➔ Guidelines for the organization of collection and disposal of food waste, approved 20/01/1974 by Deputy Chief of Main housing Directorate of MHPU RSFSR;
- ➔ Instruction on the organization and mechanized cleaning of settlements, approved 12.07.1978 by MHPU RSFSR;
- ➔ Order of MHPU RSFSR from 11.07.1986 № 321 "On approval and implementation of design rules for schemes of sanitary cleaning in cities of the RSFSR";
- ➔ The accumulation rate of household waste, approved by order of the Minister of Public Utilities of the RSFSR of 13.01.1971, № 30;
- ➔ Recommendations for operation of waste treatment plants, approved 18.05.1979 by Head of the Main Directorate of improvement of MHPU RSFSR;
- ➔ Recommendations for the design and operation of plants for the incineration of municipal solid waste, approved 29.06.1987 by Head of the Main Department of improvement of MHPU RSFSR;
- ➔ Resolution of the Council of Ministers of the RSFSR from 04.04.1974 № 208 "On strengthening the interest of businesses, organizations and collective farms in the collection of worn parts of cars, tractors and agricultural machinery, and on additional measures for their rehabilitation";
- ➔ Resolution of the Council of Ministers of the RSFSR from 17.02.1981 № 94 "On measures to further improving the organization of the collection and processing of ferrous metal scrap and waste";
- ➔ Resolution of the Council of Ministers of the RSFSR from 09.03.1981 № 488 "On measures for further improvement of the collection and scrap recycling of non-ferrous metals";

- Resolution of the Council of Ministers of the RSFSR from 11.19.1982 № 603 "On improvement of industrial use of ferrous waste";
- Resolution of the RSFSR Council of Ministers from 24.03.1980 № 150 "On measures of further improving the organization of the collection and use of waste oil";
- Resolution of the Council of Ministers of the RSFSR from 07.05.1980 № 237 "On measures of further improving the use of recycled materials in the national economy of the RSFSR";
- Recommendations for remediation of landfill areas after closing. - Sverdlovsk, 1983;
- Recommendations for the choice of methods and organization of the removal of household waste. - M., 1985;
- Recommendations for the design and operation of plants for the treatment of municipal solid waste into compost. - M., 1986.

In general, regulatory documents were developed and implemented by the Ministry of Housing and Public utilities, controlled by the sanitary-epidemiological service and did not belong to the sphere of environmental protection. Secondary resources were not considered as municipal waste, collection and recycling of them were ruled by another set of documents.

### 12.2.2 Development of waste management situation and infrastructure

#### Before 1990

##### Data and its availability:

Currently, data on MSW management almost did not save in the RSFSR. In addition, since the problem of waste nor in the USSR nor in the RSFSR did not exist, this activity was not a subject of the statistical accounting. The amount of removed waste (sanitary cleaning) was calculated only. Waste management required the calculating of containers number and vehicles, but this information was not included in the statistical reports. Information about removed waste (not generated waste) and landfilled waste was most often represented based on the rates (*norms*) of MSW because landfills and Special au-

tomobile companies were not equipped with weights. Documentation of Special automobile companies (waste management schemes, plans and reports) either was not saved or is stored in the public archives.

General scheme of municipal waste management:

Scheme of MSW management in the RSFSR was the same as in the whole of the USSR: food waste was separately collected; glass, waste paper and scrap of ferrous and non-ferrous metals were collected as secondary resources. All rest waste (mix waste) was transported to landfills. Only a few waste treatment plants (for composting and incineration) were in operation throughout the whole RSFSR.

MSW generation

Available data on the generation and storage of waste in the RSFSR is presented in Table 27.

Table 27: Generation and storage of toxic waste in organized and unorganized landfills 1990

Indicator	Number
Storage area of organized waste disposal on 01.06.1990, ha	11082,2
Amount of waste in repositories of organized storage on 01.06.1990, ths t	16127436
Generated waste during the period from 05.31.1989 to 01.06.1990, ths t	74561,9
Removed to unorganized places of storage, tones	3883,0
Including to the landfills, ths t	1332,1

Waste composition

The study of the morphological composition of MSW was carried out for the organization of waste treatment. Information about the morphological and chemical composition of solid waste is presented in Table 28 and Table 29 respectively.

Table 28: Morphological composition of MSW (Sanitary cleaning..., 1990)

Component	Content,% by mass, depending on the climatic zone		
	Central	South	Central
Paper, cardboard	25-30	20-28	21-24
Food waste	30-38	35-45	28-36
Wood	1,5-3	1-2	2-4
Ferrous metals	2-3,5	0,5-2	3-4,5
Non-ferrous metals	0,2-0,3	0,2-0,3	0,2-0,3
Textile	4-7	4-7	5-7
Bones	0,5-2	1-2	2-4
Glass	5-8	3-6	6-10
Leather, Rubber	2-4	1-3	3-7
Stones	1-3	1-2	1-2
Plastic	2-5	1,5-2,5	2-4
Other	1-2	1-2	1-3
Screenings (less than 15 mm)	7-13	10-18	7-13

Table 29: Chemical composition of MSW (Sanitary cleaning..., 1990)

Component	% of dry mass, depending on the climatic zone		
	Central	South	North
Organic matter	56-72	56-80	55-60
Ash content	28-44	20-44	40-45
Total nitrogen	0,9-1,9	1,2-2,7	1,2-1,6
Calcium	2-3	4-5,7	2,1-4,8
Carbon	30-35	28-39	28-30
Phosphorus	0,5-0,8	0,5-0,8	0,4-0,5
Total potassium	0,5-1	0,5-1,1	0,4-0,5
Sulfur	0,2-0,3	0,2-0,3	0,2-0,3
The reaction medium pH	5-6,5	5-6,5	5-6,5
Humidity,% of the total mass	40-50	40-70	43-48

### *Waste collection and transportation, landfilling and treatment*

Collection and transportation of solid waste, landfilling and treatment were carried out according to the scheme already described in *section 11.2.2*.

Recycling

System of recyclables collection is described in *section 11.2.2*. General information about the use of recycled materials in the RSFSR is shown in Table 30.

Table 30: Use of recycled materials (Economy of RSFSR in 1990)

Type of secondary raw materials	1985	1986	1987	1988	1989	1990
Polymers, ths t	118	128	158	162	157	158
Used tires, ths t	67	134	139	137	119	97
Waste paper, ths t	1424	1514	1557	1634	1604	1623
Glass, ths t	393	441	414	399	429	366

After 1990

Legislative and regulatory documents in Russia are approved at federal, regional and local levels. Federal documents are divided into several groups:

- **Federal Laws, Codes and Resolutions of the Government:**

- Housing Code of the Russian Federation;
- Federal Law from 24.06.1998 № 89-FZ (as amended on 25.11.2013) "On Industrial and Consumption Waste";
- Federal Law from 04.05.2011 № 99-FZ (as amended on 02.07.2013) "On licensing certain types of activities";
- Federal Law from 10.01.2002 № 7-FZ (as amended on 03.12.2014) "On Environmental Protection";
- Federal Law from December 30, 2004 № 210 "On the basis of tariff regulation of utility organizations";
- Order of the Ministry of Natural Resources of the Russian Federation from 15.06.2001 № 511 "On approval of the criteria for classification of hazardous waste classified as dangerous for the environment";



- Order of the Ministry of Natural Resources of the Russian Federation from 02.12.2002 № 786 (Ed. of 30.07.2003) "On approval of the federal classification catalogue of waste";
  - Resolution of the Government from 28.03.2012 № 255 (as amended on 05.02.2013) "On the licensing of disposal and storage of waste I - IV classes of danger";
  - Resolution of the Government from 11.05.2001 № 370 (as amended on 12.12.2012) "On Approval of Rules for the treatment of waste and scrap of non-ferrous metals and their alienation";
  - Government Resolution from 16.08.2013 № 712 "On the procedure for certification of waste I - IV classes of danger";
  - Resolution of the Government from February 10, 1997 № 155 "On Approval of the Rules of Service for the removal of solid and liquid waste";
  - Resolution of the Government from August 21<sup>st</sup>, 2001 № 609 "On measures for the elimination of the system of cross-subsidization of water supply services to consumers, wastewater, district heating, as well as destruction, recycling and disposal of municipal solid waste";
  - Resolution of the Government from May 23<sup>d</sup>, 2006 № 307 "On the procedure of public services to citizens", and etc.
- **Sanitary rules and regulations, construction codes, standards and specifications:**
    - "Hygienic requirements to the design and maintenance of landfills for solid waste. JV 2.1.7.1038-01" enacted by resolution of Ministry of Health of the Russian Federation from May 30, 2001 №16;
    - "Sanitary rules for maintenance of settlements" (SanPiN 42-128-4690-88);
    - "Hygienic requirements to placement and disposal of industrial and consumption waste. SanPiN 2.1.7.1322-03 ", enacted on June 15, 2003;

- "Guidelines for the design, operation, and reclamation of landfills of MSW" (approved by the Ministry of Construction of Russia 11.02.1996.), and etc.

In accordance with the Federal Law № 89-FZ "On Industrial and Consumption Waste" under the concept of "waste management" means the activity, during which the waste is generated, collected, used, treated, transported and landfilled.

In accordance with the criteria approved by the Ministry of Natural Resources of the Russian Federation in Order from 15.06.2001 № 511, MSW has III-IV hazard class. In accordance with the Regulation on licensing of hazardous waste, MSW management is required a license. Recycling, storage, replacement, landfilling and destruction of industrial and consumption waste are required of obligatory licensing.

The new version of the Law № 89-FZ stressed a ban on dumping waste that can be recycled. In particular this touches non-ferrous, ferrous, precious and rare metals. According to Article 13 of the Law, organization of separate collection of waste is duty of local authorities.

Comparing the first and last edition of the Law № 89-FZ allows to conclude:

1. The list of industrial and consumption waste has been extended. Waste generated during services providing was added.
2. The term of waste disposal was introduced. The law establishes the work of operators for the MSW management. The Law introduces term of homogeneous waste groups.
3. The new term "municipal solid waste" was re-introduced. Now MSW means waste generated in a residential area in the process of consumption by individuals, as well as goods that have lost their consumer properties during their use by individuals in a residential area in order to meet personal and domestic needs.
4. From under the law medical waste (previously, the waste of medical institutions), substances depleted the ozone layer, waste of exploration and production of hydrocarbons were derived.

The organization of separate collection of secondary resources is a duty of the local authorities and is not regulated by the federal legislation. The process of collection of secondary raw materials is regulated by "Sanitary rules for the collection, storage, transport and primary processing of secondary raw material» № 2524-22 from January 22, 1982. In addition, Article 6 SaNPiN 2524-82 regulates collection of secondary raw materials in landfills, which may only be carried out by specially organized teams with all the necessary precautionary measures in coordination with the local health care service. Also it is allowed to extract secondary raw materials from MSW at treatment facilities which activities must be organized in accordance with the sanitary rules. Collection of secondary raw materials (scrap metal, waste paper) by schoolchildren and students is regulated by the "Sanitary Rules for the collection of secondary raw materials by schoolchildren" №2398-81 from 02.06.81, approved by main sanitary-epidemiological department of the Ministry of Health.

Turnover of scrap and waste of precious metals is carried out on the basis of Article 4 of the Federal Law from March 26, 1998 № 41-FZ "On Precious Metals and Precious Stones" and Resolution of the Government from 11.05.2001 № 370 "On Approval of Rules for the Treatment of scrap ferrous and non-ferrous waste metals and their alienation". Scrap and waste of precious metals and gems should be collected in all organizations, should be obligatory registered and could be recycled by special organizations or sold them. The requirements of these rules make the collection of abandoned scrap and waste of ferrous and nonferrous metals impossible. In fact, it is only allowed to buy them.

All waste disposal sites should be included in a special register. The legislation prohibits the landfilling at the facilities which are not included in the register. In practice, the measure is not implemented.

Federal target program "Waste" (approved in 1998) had task "to create a regulatory and technological framework for the implementation of the unified state policy in the field of waste management at all levels". It was assumed that 80 % of the program costs will be covered by budget funds, and the rest 20 % will be provided by the profit from the sale of secondary raw materials. Unfortunately, for various reasons, which are included the lack of funding for the program in the whole, the declared objectives have not been achieved. "Principles of State Policy of the Russian Federation in the field of environmental development for the period till 2030" in regards to waste was proposed (1) organization of separate collection; (2) strict penalties for inappropriate disposal; (3) the gradual introduction of a ban on the dumping of waste suitable for recycling. Integrated

strategy for MSW management in the Russian Federation was approved by Order of the Minister of Natural Resources and Environment in August 2013. Its goal: to prevent the harmful effects of MSW on human health and the environment, as well as the involvement of the components contained in the waste into the economic turnover. Achieving the main goal of integrated strategy should be provided by finding of solutions on the following main objectives:

- improvement of the legal regulations on the treatment of MSW;
- development of an effective management system of MSW;
- development of infrastructure for separate collection, recycling (use), decontamination and environmental and sanitary-epidemiological security landfilling of MSW;
- ensuring environmental and sanitary-epidemiological safety during collection, treatment and disposal of MSW;
- implementation of economic mechanisms for MSW management;
- improvement of pricing for MSW management;
- development of the system of environmental and sanitary-epidemiological education and awareness in the field of MSW management;
- ensuring the collection and submission of accurate information on MSW management.

Concept doesn't provide the values of indicators.

The Russian legislation provides a number of basic rights and obligations associated with MSW management. The distribution of power and functions between actors is presented in Table 31.

Table 31: Distribution of power and functions of WM actors in Russia

<b>Function</b>	<b>Subject</b>
Direct ownership on the waste. The duty to avoid negative impacts on the environment	People, organizations, entrepreneurs
The right to have benefit from disposing of assets, transferring ownership. The obligation to compensate the actual impact on the environment	Organizations, businesses
Organizing the collection and removal of garbage from the settlement area	Municipality

Organization of waste utilization (landfilling)	Federal subject
Proper use of infrastructure and provision of services for the collection, removal and disposal of waste for a fee	Authorized the contract specialized organizations
Licensing and monitoring of the proper provision of services, evaluation of technical, sanitary and environmental safety of existing facilities and construction	Regional offices of the federal agencies Rostekhnadzor, Rosprirodnadzor,

As could be seen from Table 31, the ownership of the waste and the duty to organize the MSW management is actually divided. Separation of ownership and responsibility for MSW management has a number of negative consequences:

- ➔ Disinterest of small operating companies working in "difficult" sectors of the economy, "tariff pressure" on the local administration;
- ➔ The threat of monopoly of municipal companies (the desire to control the administration of the whole list of services), inefficient tariff and fiscal policy;
- ➔ Limited access to the market of companies with the necessary technological and financial capacity to address the problem of waste management (IFC's the World Bank Group, 2010).

The power of the Russian Federal governmental bodies in the field of waste management:

- Policy authority for regulation in the field of environmental taxing: the establishment of standards for disposal, the collection rates, the order of self-utilization, control over the payment of environmental tax, development of a unified state information system for accounting and calculation of industrial and consumption waste, etc.
- the regulation of turnover of waste I-VI danger classes: the establishment of requirements for storage facilities, waste burial and landfilling, the establishment of the procedure for inclusion waste in Register according to their hazard classes, waste certification, etc.;
- the relationship related to pricing and tariff policy in the sphere of MSW management, as well as civil and legal relations in the sphere of service provision for MSW management.

Federal Law №131-FZ from October 6, 2003 "On general principles of local self-government in the Russian Federation" states that organization of collection and disposal of MSW is an issue of local city self-government (art. 14.1, art.18). The issues of local government (level of the municipal district) include the organization of recycling and treatment of MSW (art. 15.1, art. 14).

Thus, everything directly related to the MSW activities is the duty of local self-government and the responsibility of the owners. Everything related to the regulatory documentation and control is the exclusive duty of government. In other words, local self-government can not regulate and control MSW activities, but responsible for its implementation.

### 12.2.3 Legal and economic instruments to support waste management hierarchy

#### **Before 1990**

See *section 11.2.3*. It should be mentioned that local and regional initiatives for support of waste management hierarchy were implemented in RSFSR.

So, in Astrakhan due to the inability to organize points-shops quickly, special store was opened. People could buy any goods at this store with permission from collecting points for recyclables about amount and sum of collected raw materials. It was given the opportunity to take into account seasonal demand, to concentrate goods in one place for better control and storage. Astrakhan experience was recommended for implementation in all small cities of the USSR.

Novosibirsk city was initiator of action "*Imaginative literature in exchange on waste paper*". So, trust "Novosibvtorsyre" bought in bookstores books and removed them to points-shops. People could pick up every type of recyclables – textile or plastic or paper – and exchange them on books. In spite on quite high required norm of collected waste textile (10-15 or even 20 kg), all books were sailed in short terms. It was allowed to achieve all planned indicators on collection of waste textile and other recyclables.

**After 1990***Data and its availability*

The current system of accounting and control of waste generation and disposal in Russia is decentralized; it does not include a complete and detailed performance of MSW management system and does not allow obtaining reliable information on the actual volumes of waste in the whole of Russia, as well as in separate regions (MDS 13-8.2000, 1999). Soviet statistical forms were abolished; Russia's new forms are either absent or do not include detailed records of the MSW management system.

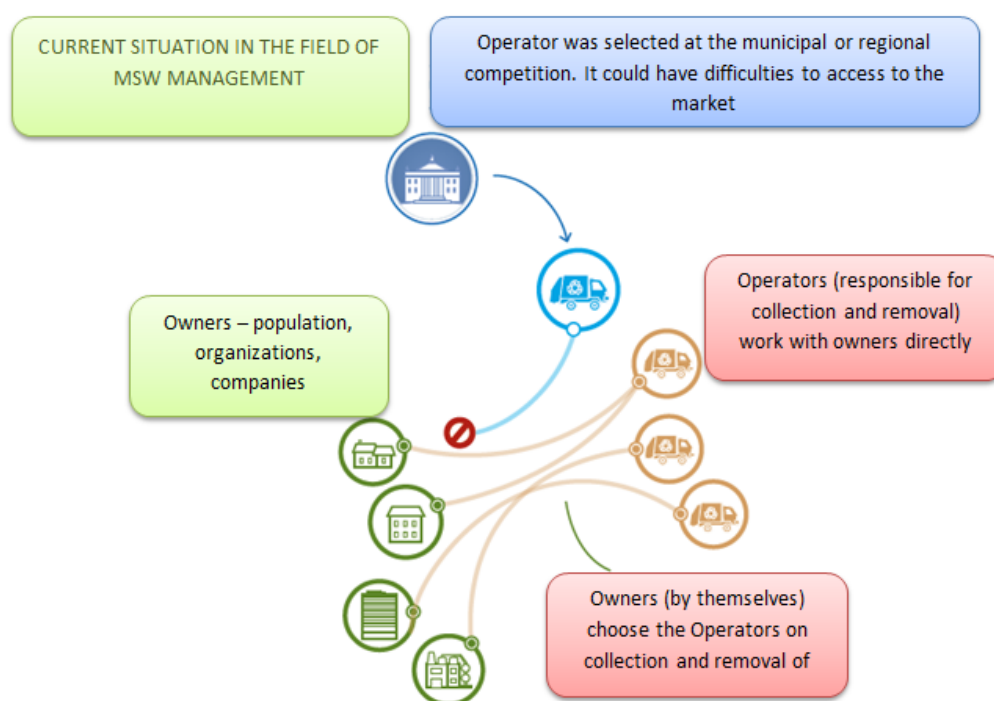


figure 47: Main players in the field of MSW management in Russia (IFC's the World Bank Group, 2010)

Resolution № 818 from 26.10.2000 "On the order of the state cadaster of waste and carrying out certification of hazardous waste" puts responsibility to maintain Waste cadaster to Ministry of Natural Resources. The maintenance of the Waste cadaster in regards to MSW management is carried out by this Ministry and its territorial bodies in cooperation with the State Construction Committee of the Russian Federation. Calculation of municipal solid waste is carried out in the column 48 "solid waste removal," section 3 of the form № 22 Housing (summary), approved by Order of the Federal State Statistics

Service from 11.08.2009 № 168 "On approval of statistical tools for the organization of federal statistical monitoring of implemented activities in the field of housing and communal services".

Currently, statistics agencies collect information about the volume and hazard class of waste generated at the municipality or company, the number of objects treated and landfilled in the region. Regular centralized collection and analysis of data on the main fractions (packaging, hazardous or bulky waste) is not carried out, and the operator (or the municipality, as the initiator of the project), as a rule, carries out such analysis on their own (ZKH, 2013). Results of such investigations are not processed at the federal level; the official statistics on this issue does not exist

Information about the amount of waste is not always reliable. Reporting forms are often conducted based on outdated standards in cubic meters, the data in tons is not available (because at the landfills weighting is not always carried out). Earlier the calculation of MSW was produced based on volume indicators, which was dictated by the need to calculate the capacity of containers. Indicators in kg or tons became relevant with starting calculation of share of recyclables (ZKH, 2013). New blank form of federal statistical observation № 14 MET (scrap) "Information about generation and use of ferrous and non-ferrous metals" ([Rosstat Resolution](#) from 24.07.2006 № 38 "On approval of statistical tools for statistical monitoring in 2007") was applied. This blank form is obligatory only for recycling companies, and don't cover wholesalers. In addition, the blank form doesn't account the amount of collected junk scrap which just purchased or transferred as raw materials.

### MSW Generation

The Russian statistics, as well as in Belarus, is taken into account not generated MSW but amount of removed and landfilled municipal waste. These values are equal, and as noted in the description of Belarus, this data does not reflect the real situation. Moreover, as a result of reforms in the Russian statistical, data on removed and landfilled MSW in the 2006-2009 period is completely absent in the official statistics. During this period, generated waste was taken into account by economic activity, so there was a lack of information about municipal waste. Available data on MSW generation in Russia are shown in Table 32 and Table 33.



Table 32: MSW generation and treatment in Russia in 2001- 2005 (Sycheva&amp;Asadcheva, 2013)

Year	Removed MSW, total		MSW transported to recycling plants		
	ths. m <sup>3</sup>	ths. tons *	ths. m <sup>3</sup>	ths. tons *	%
2001	148539,7	29707,94	6995,4	1399,08	4,7
2002	159574,8	31914,96	10334,6	2066,92	6,5
2003	170784,9	34156,98	15709,3	3141,86	9,2
2004	183316,8	36663,36	18347,1	3669,42	10,0
2005	270998,3	54199,66	23714,0	4742,8	8,8

\* Baseline data from thousand m<sup>3</sup> have been translated authors in tons by multiplying by a factor of 0,2

In 2000, indicator of MSW per capita per year was equal to 220 kg, in 2010 - 330 kg (IFC's the World Bank Group, 2010), and in 2014 – to 440 kg (according to [publications in the media](#)).

Table 33: MSW generation in Russian Federation (State report, State report “On status and protection of the environment in Russian Federation in 2014”, 2014)

Indicator	2007	2011	2011	2012	2013	2014
the amount of generated municipal solid waste*, mln t	N / A	47.082	48.228	53.122	53.703	56.68

\* The volume of generated, recycled and treated municipal solid waste (MSW) must be submitted by Rosprirodnadzor, which is in charge for federal statistical observation in according to form 2-tp (waste). Due to lack of data from Rosprirodnadzor in 2014 and the low reliability of the data presented by this agency in 2012-2013, estimation of the volume of generated, recycled and treated MSW was conducted according to Rosstat data on the amount (in m<sup>3</sup>) of removed waste. For comparison it was use the value of the density of the waste equal 200 kg / m<sup>3</sup>.

### Waste composition

Systematic investigation of MSW composition has not been conducted in Russia. The only source of statistical information is micro-studies which were carried out by operators and associations for different regions at different times. Their conclusions are different from each other. For example, according to the Recycling association, the share of paper / cardboard and glass in Russia is 41 and 3 % respectively, whereas according to the other operators - 16 and 12 % respectively. This wide range of indicator values can be explained by non-representative samples (IFC's the World Bank Group, 2010).

Based on available information we can conclude about reducing share of the organic fraction and the increasing share of inorganic, or non-degradable fractions, in particular packing waste (paper, plastic, glass). In 2000, the share of organic waste was about 40 % of MSW (figure 48), by 2011 its share decreased by 6-10 %, and the share of fractions suitable for recycling increased. The category "Other" includes hazardous waste and bulky waste, WEEE, as well as other less important types of waste.

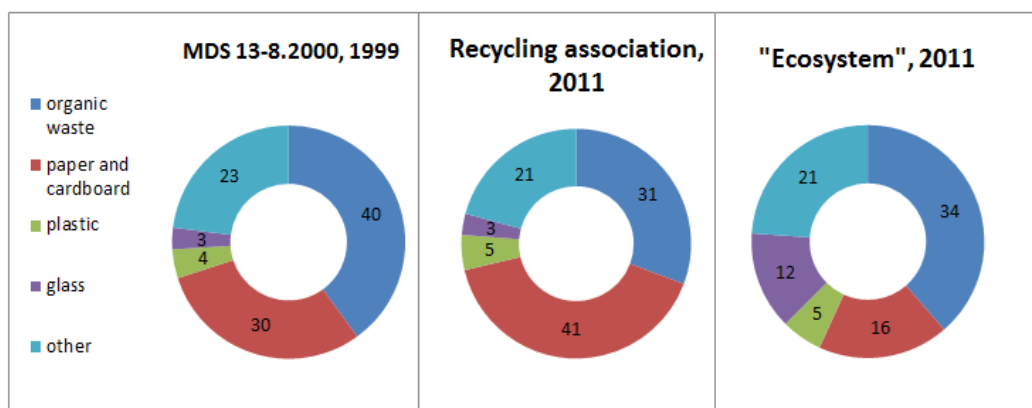


figure 48: Waste composition in Russia (IFC's the World Bank Group, 2010)

### Waste collection and transportation

The first stage of the waste management system is the organization of the collection in the places of MSW generation. Mix waste is collected for choice in Russia. Separate waste collection in places of their generation is implemented in few cities on a trial basis. Indicatives and pilot project will be described below in special section. Mix waste is collected in metal containers installed at the household area. The type and capacity of used containers depend on the amount of accumulated waste, type of housing as well as the manner of loading and removal of solid waste. There is a lack of data on number of containers, their capacity, material and etc. in available sources. According to publications in different sources, metal containers are dominant type of used bins for MSW collection. Metal containers have a considerable weight, low corrosion resistance and adhesion to the wet waste, as well as high costs of their operation. The service life of such containers is not more than 2 years, which is in 2-2,5 times below norm. The annual losses of steel (due to short operation time of metal containers) are about 5-7 mln t for Russia in the whole (MDS 13-8.2000, 1999).

Removal of solid waste may carried out by specialized organizations with technical facilities and permit (license). Management companies (as well as condominiums, HBC

and individuals) must sign contract with such specialized organizations about removal of MSW. In their turn, specialized organizations establish tariffs on their services based on costs of fuel and lubricants, labor, etc. Management companies include this price in the bill for tenants. Thus, the residents produce waste; management companies organize MSW management; and the direct collection and disposal are carried out by contractors. The number of organizations engaged in the removal of solid waste is presented in Table 34.

Table 34: Number of organization providing services for removal, treatment and land-filling of solid waste in Russia in 2005 (Sycheva&Asadcheva, 2013)

Territory	The number of municipal organizations	The number of private organizations
Russian Federation	185	157

According to Rosstat (ZH, 2013), the number of vehicles used for cleaning up of urban areas and removal of household waste in the past 15 years has increased significantly (Table 35). Official statistics does not allow concluding reliably: this data relates to number of specialized vehicles for MSW removal or just number of municipal cars for cleaning streets.

Table 35: Number of specialized vehicles used for cleaning areas and disposal of household waste (ZH, 2013)

2000	2004	2005	2006	2007	2010	2011	2012
52930	58851	57596	57051	59520	63094	70280	70855

Average distance of MSW transportation for Russia is 20 km. In the major cities with population over 500 ths people this distance rises to 45 km and more. According to a survey of 100 cities in Russia (excluding Moscow and St. Petersburg), approximately 45 % of MSW are transported in distance of 10-15 km, 40 % - 15-20 km, and 15 % - more than 20 km. Statistics data shows that the distance increases every year on 1,5 km, and the transportation cost rises respectively on 15-20 % (MDS 13-8.2000, 1999). One of the real ways to reduce transport costs is construction of waste transfer stations for organization of two-phase system of solid waste removal and use garbage trucks with bigger capacity.

Sorting MSW

According to (Cleandex report, 2010), there were 39 waste sorting plants in operation (beginning of 2010) in Russia. Their average capacity is about 180 000 tons per year, which is comparable with the amount of waste generated in small towns (IFC's the World Bank Group, 2010). Waste sorting plants are functioning in Togliatti, Belgorod, Moscow, St. Petersburg, Voronezh, Ufa, Arkhangelsk, Maloyaroslavets, Almeteyevsk, Barnaul and other cities. Basic operations performed by this group of companies (Cleandex report, 2010) are:

- collection and transportation of mix MSW to sorting line;
- Waste sorting with selection of recyclables;
- presswork of waste components for further processing;
- removal of non-recyclable waste for landfilling.

Sorting of MSW could be carried out by either informal landfills gangs (homeless working at landfills provide sorting of 40-50 % of received waste), as workers of waste sorting plants. Typically, MSW sorting is done by hand. Sorting line is equipped by certain working places, where operators select dry waste: paper, cardboard, plastic, glass, PET bottles. The final production of the sorting process is briquetted recyclables (Cleandex report, 2010): waste paper, polyethylene, PET bottles, aluminum cans, etc., supplied to industrial enterprises for further recycling or composting (organic fertilizer and bio-fuels). The largest enterprises are:

- JSC "Arkhangelsk waste plant» - 110 ths t/yr;
- JSC "Belgorod sorting plant" - 600 tons of recyclables per month;
- JSC "Clean City "(Republic of Tatarstan) - 200 ths t/yr;
- JSC "Treatment facility for municipal solid waste" (Samara region) - 100 ths t/yr;
- Ulan-Ude recycling plant (Republic of Buryatia) - 80 ths t/yr, and others.

The reasons for the lack of business development for sorting MSW (Economic aspects..., 2015) are:

- Most of the useful materials have been already selected by declassified elements in the places of waste collection, that leads to, respectively, low incomes of sorting plants;
- The market for recycling in Russia is underdeveloped, that leads to reduction in product prices (extremely large);
- Sorting process itself takes more labor costs due to a behavioral model of public in the field of MSW collection.

### Recycling and treatment

MSW recycling capacity in Russia is estimated at 14 million tons. It is recycled not more than 10 % of solid waste, which of approximately 3 % is burned, and 7 % is transported to industrial recycling plants (Cleandex report, 2010). According to (Cleandex report, 2010), there were 4 incineration plants (located in Moscow); and 5 waste treatment plants in Russia at the beginning of 2010.

Assessment of MSW recycling capacity is an approximate, there is a lack of data on collection of recyclables from the population, because the state system "Gossnab" operated in the field of recycled materials was totally destroyed in 1991. In 1996 statistic reporting about recycled resources (14-BP), wood waste (14-forest) and scrap of ferrous (9-CH) and non-ferrous (17-CH) metals was abolished. Available information about the amount of use and disposal of waste (both industrial and municipal) are presented in Table 36. The utilization of waste as secondary raw materials in Russia does not exceed one third.

Table 36: Total use and disposal of waste in Russia Federation by economic activity (State report, State report "On status and protection of the environment in Russian Federation in 2014", 2014)

Waste, mln t	2007	2010	2011	2012	2013	2014
The total amount of waste use and disposal	2257,4	1738,1	1990,7	2348,1	2043,6	2357,2
Out of it:						
Agriculture, forestry and fishing	19,2	19,8	23,4	23,2	34,7	33,6
Mining	1829,4	1562,2	1800,1	2125,9	1753,1	2165,7
Manufacturing	85,4	124,4	124,3	164,6	132,3	119,3
Construction	38,8	10,1	11,3	10,3	8,9	7,7
Production and distribution of electricity, gas and water	8,3	9,8	13,3	9,2	3,8	4,3

Other economic activities	276,3	11,8	18,3	14,9	110,8	26,6
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Scheme of recycling in Russia is shown in figure 49. Collection of solid waste for recycling is carried out by both internally (companies pick up collected recyclables according to order, or companies install containers for separate waste collection) as well as by third parties (based on collecting points opened by companies for collection of certain types of solid waste).

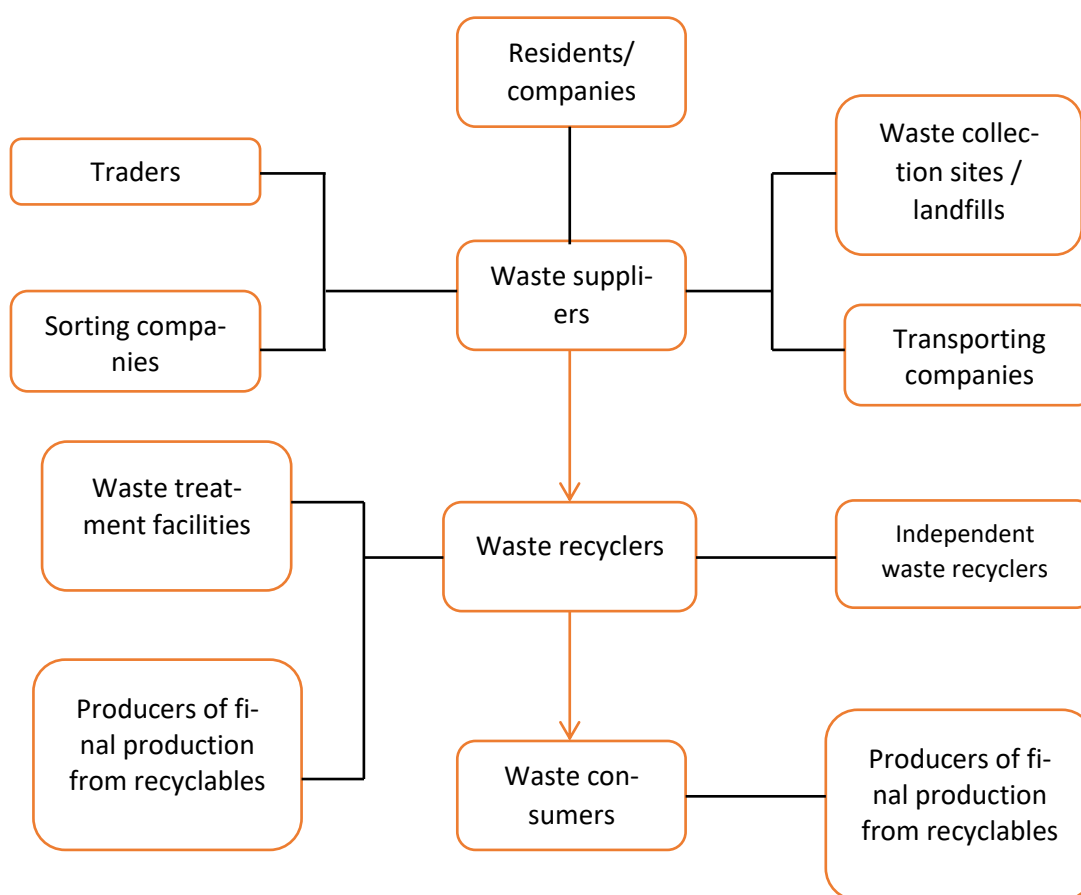


figure 49: Actors in recycling in Russia (Cleandex report, 2010)

“Clean” waste recyclers are met rarely, because their main activity is typically production from primary or secondary raw materials. These companies offer, in particular, the services of a third-party recycling. They received waste, treated them and produced granular materials, and after that returned them to the original owner. Owner pays for waste recycling service. The cost of such service is, for example, 8-10 rub./kg at plastic

waste market. In order to provide the best logistics and competitive prices, many waste recyclers are located near to producer of raw materials.

Price of purchasing for waste varies from 600 to 8000 rub./t (Table 37). According to market participants, the recycling process leads to higher cost of receiving sorted waste by an average of 50 %. The cost for recycling can be in 1,5 times lower than the cost of primary material.

Examples of companies specialized in recycling of certain kinds of solid waste:

- Company "Energotorgservis" (Nizhny Novgorod region) - 20 tons of cullet per day;
- "Ekoplastik" (Kemerovo Region) - 500 kg/h of PET bottles, 300 kg/h of polyethylene;
- Company "Ekoshina" (Primorsky Krai) - 5000 tons of waste tires per year;
- JSC "Chekhov regenerative plant" (Moskvovskaya area) - up to 8000 tons of tires per year;
- SW project (Moscow region) - 250 tons of plastic waste per month, and etc.

Table 37: Price of collected recyclables (Cleandex report, 2010)

Recyclables	Type of recyclables	Price, rub./ton
Waste paper	MS-1A	4000-8000
Waste paper	MS-2A	2500-5000
Waste paper	MS 6B, 7B-MS / 1-7B MS / 2, MS-7B / 3, MS-8B / 1, MC-8B / 2	1000-2500
Broken glass	-	1200
Used Tires / y	Car's tires	3000-3500
Used Tires / y	Freight tires	2000-2500
Waste rubber	category 1	3200
Waste rubber	2 categories	3000
Waste rubber	3 categories	2500
Batteries	-	6600
Rags	-	600-1000
Plastic	-	7000

### Incineration plants.

All currently existing incineration plants (WIPs) are located in Moscow. Annually, they burn about 700 ths t of solid waste, which is only 13 % of the total amount of generated MSW in the capital (Cleandex report, 2010).

WIP № 2 SUE "Ekotekhprom». For the first time the plant was put into operation in 1975. In November 2000, it was renovated; two new production lines "KNIM" (France) were installed. Additional third line was installed in December 2004. Production capacity is 130 ths t of waste per year. German technology of incineration by "Martin GmbH für Umwelt und Energietechnik" was implemented at the WIP. The effectiveness of flue gas treatment, resulting from the incineration is 99,8%.

WIP № 3 (JSC "EVN - Ekotekhprom MSZ 3"). For the first time WIP was put into operation in 1983. In 2005 it was stopped. In result of international competition organized by Moscow Government JSC "EVN" (Austria) was declared the winner and received a contract for the reconstruction and operation of WIP №3. Start of new WIP was in 2007 in the same area, where the old WIP was located. The total amount of investments is about 175 mln euros. JSC "EVN" together with the Moscow specialized organization will operate WIP until 2019, and then it will become the property of Moscow. Production capacity is 360 ths t of waste per year. It was established 2 production lines.

WIP № 4 SUE "Ekotekhprom". The plant is operated since 2005. In 2008, the WIP received 263 ths t of solid waste, that more on 3,5 % than in 2007. It was produced 67mln. 638 ths. KWh of electricity, that more on 13,4 % more than in 2007. 70 % of the electricity was used for own needs and 30 % released in "Mosenergo network". Production capacity is 250 ths t of waste per year. Resolution of the Moscow Government №313-PP provides an increasing capacity of WIP №4: 1st stage - from 250 to 280 ths t of solid waste per year; 2<sup>nd</sup> stage - from 280 to 600 ths t of solid waste per year.

### Landfilling

About 90 % of solid waste in Russia is transported to landfills. According to (Cleandex report, 2010), there are 11 000 landfills and dumps in Russia at the beginning of 2010. State agencies provide other data. According to data of Federal Service of Supervision



of Natural resources, at the beginning of 2010, 7518 waste disposal sites were registered in Russia:

- 1699 MSW landfills;
- 576 industrial waste storage facilities;
- 5243 illegal dumps.
- 

One of the main trends is the growth of the total area of the landfills. Annually, 7-10 ths ha was additionally used for landfilling. Total area of landfills and dumps is more than 2 mln ha. It should be noted that a significant share of solid waste goes to illegal dumps, whose number is constantly growing (Cleandex report, 2010). According to the MNREP of the Russian Federation, at the beginning of 2011 it was accumulated 32 bn t of all types of waste: industrial, agricultural, municipal at MSW landfills (according to other estimates, about 60-70 bn t) (IFC's the World Bank Group, 2010). The share of MSW landfills is about 50 % in Russia, and only 8 % from them meet environmental requirements (IFC's the World Bank Group, 2010). 90 % of existing landfills are operated without a license (Economic aspects..., 2015). The power for waste disposal and maintenance of landfills was transferred to municipalities in 2006. But any funds (for construction, maintenance or renovation as well as ownership) were not transferred together with power.

#### 12.2.4 Waste management system financing

##### **Before 1990**

See *section 11.2.5*. Information about tariffs for households and companies on waste disposal for the RSFSR is not available.

##### **After 1990**

According to the Housing Code of Russian and Decision of Government № 307, removal of solid waste is not the communal service. However, it is included in the fee for maintenance and repair of the dwelling. As a general rule, the fee for maintenance and repair of the dwelling in multistory apartments without Management Company is established

at the general meeting of owners. If the house is governed by Management Company, the size of fee is established by Company together with the tenants.

Framework of tariff policy on removal and landfilling is established in Federal Law №210-FZ "On the regulatory framework for tariffs of housing public utilities". Today, each tariff of communal service, including tariff on the removal and recycling of waste, should be reconciled with the authorized body. If the case when tariff is calculated in excess of operational needs, and does not correspond to the volume of production or tariff excludes the possibility to use the service due to the high cost, the authorized body could propose to decrease tariff, or calculates and establish its own tariff.

Directly in the regions the body in charge for establishing of tariffs is the Committee on Tariffs, or Tariff Department, etc. In addition, tariffs in the municipalities are established in accordance with distribution of power and responsibilities in specific region – by executive (the administration) or representative body (council of deputies). The Russian government, in turn, claims the basic of pricing rules and regulation of tariffs for goods and services, allowances to tariffs on goods and services and prices for consumers. Framework of pricing and regulations is approved by the Resolution of Government from 14.07.2008 № 520.

Fees from population and companies paid according to tariffs for waste disposal is the main financial source of WM sector in Russia. The tariff for the end user consists of fees for collection, transport and landfilling of waste. By analogy with the tariffs for communal services, payment is usually formed according to principle "cost-plus" for each user of landfill. Billing for individual households is usually calculated in dependence on the housing area, and the provision of service is normalized per square meter. Tariffs and norm of accumulation do not often have reasonable foundations; that leads to varying fees from region to region. The current scheme of establishing tariffs and fees is shown in figure 50.

The current practice leads to 2 main problems (IFC's the World Bank Group, 2010):

1. Payment "un-transparent" for the consumer: it is not often linked to the actual amount of waste. Its size doesn't depend on provided services;
2. The payment is not sufficient for the operator: it often does not cover the cost of maintenance of environmentally safe infrastructure.

The level of compensation of service costs, including the removal and disposal of solid waste was 83 % in 2013 (ZH, 2013).

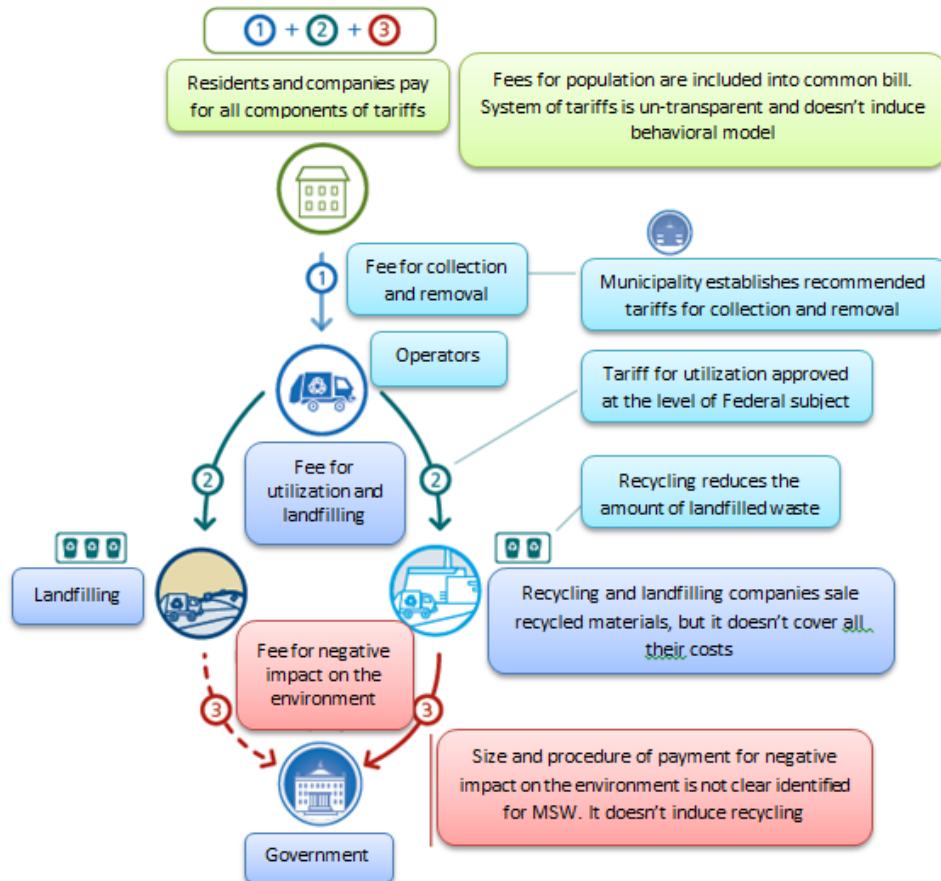


figure 50: System of tariffs and fees for MSW removal and disposal in Russia (IFC's the World Bank Group, 2010)

Resolution of Government № 632 from 28.08.92 "On Approval of the Procedure for calculation of fee and its limits for environmental pollution, waste disposal and other harmful effects" establishes the procedure for calculation of fees landfilling of industrial and consumption waste at dumps.

Funding of the treatment of solid waste is carried out, also, from the federal budget under investments in environmental protection measures. The dynamic of investments is shown in figure 51.

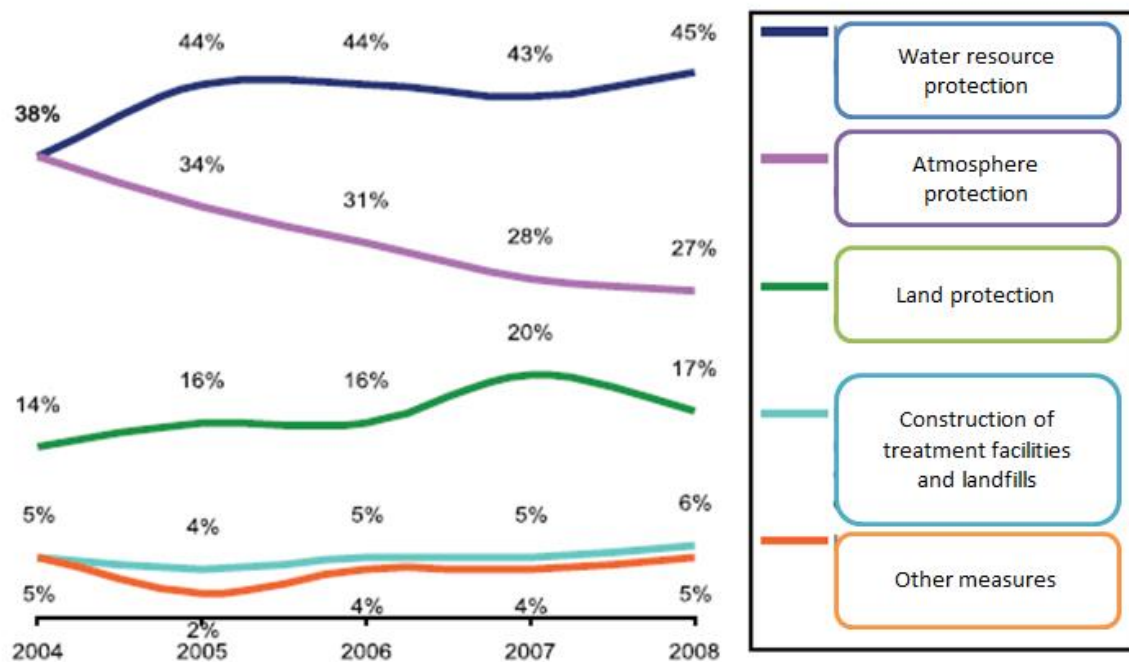


figure 51: Investments in protection of environment in Russia in 2008 (State report, "On status and protection of the environment in Russian Federation in 2008", 2008)

### 12.2.5 Public awareness, education and communication initiatives

#### Before 1990

See *section 11.2.5*.

#### After 1990

The reports and publications describe the low level of environmental culture of the population in the field of solid waste and hazardous waste management. At the same time today there is no sound policy related to MSW management in education and increasing environmental awareness. This sector is represented by individual projects and public initiatives.

**St. Petersburg experiment for increasing MSW treatment and recycling.** Participation in the experiment of legal entities is voluntary. The declared volume of MSW recycling is 21 % of the total amount of waste. The procedure of the experiment is approved by the Committee of improvement of the St. Petersburg Government.

**Pilot project on MSW separate collection in Murmansk.** In 2011 pilot project on MSW separate collection was implemented within the framework of Murmansk municipal program. 22 garbage containers for separate collection of glass, paper and plastic were installed in one of the city district. Separated waste was sent for recycling after additional manual sorting. The project was spent nearly 2 mln rub. from budget and 700 ths rub. from private investor. The project covered about 10 ths people, but the real participation was only 4 %. During the project 2 t of paper, 210 glass bottles and almost 910 kg of broken glass, metal 157 kg and 50 kg plastic were collected (IFC's the World Bank Group, 2010).

**Ufa project on MSW separate collection.** Currently, for the project implementation was identified 20 container sites in the Ordzhonikidze district of the city. Containers for separate collection of food waste, PET bottles and bulky waste were installed at the sites. Waste removal is carried out twice a day: first trip takes away food waste, second trip takes away solid waste. In order to inform residents about separate waste collection the posters are disseminated everywhere (ZKH, 2013).

**Irkutsk automatized information system on MSW (AIS "Waste").** Project cost is about 1,5 mln rub., spent from local budget. In addition, MUE "Spetsavtohozyaystvo" spent 300 ths rub. for the purchase of electronic scales which were installed at Irkutsk landfill (ZKH, 2013).

**"Greenpeace Russia" project "Interactive Map of collecting points for recycling"** (<http://recyclemap.ru/belgorod>). In 2011, "Greenpeace Russia" launched an e-map project detected collecting points for recyclables in Moscow region. With volunteers' help (after preliminary check) collecting points were depicted with indication of processing types of recyclables. At present e-map includes more than 250 collecting points in Moscow region, information about collecting points in St. Petersburg and Obninsk. In the near future project will be extended: it was supposed to develop regional maps for Vladivostok, Omsk, Chelyabinsk, Murmansk, Novokuznetsk and other cities.

**City target program of environmental education and public awareness of Elista "For clean city!"** Implementation of program was in 2009-2011. The program had impressive success and was prolonged on 2012-2014. Results of program: (1) reducing illegal dumps; (2) improvement of sanitary-hygienic well-being; (3) development of environmental education, and public awareness. The program was implemented at expenses of municipality (ZKH, 2013).

### 12.2.6 Barriers and success factors for waste management performance

#### Before 1990

See section 11.2.6.

#### After 1990

In general, abundant natural resources and their availability at affordable prices do not induce recycling in Russia and don't stimulate the development of sound state policy in the field of WM. It could be argued that the main reason of low level of recycling is a shortcoming of institutional mechanisms (Cleandex Report, 2010a). All barriers in MSW management could be divided into organizational and administrative; financial and economic; cultural and information.

**Organizational and administrative barriers** slow down appearance of new players in the market, because untransparency of market conditions. Interested participants can not get access to the full information required for decision making. Overcoming uncertainty requires larger transaction costs. Organizational and administrative barriers also include the unclear distribution of power and responsibilities between stakeholders, the rigidity of the public-private partnership mechanisms, the lack of reliable data on waste, the problems of technical regulation and environmental oversight (IFC's the World Bank Group, 2010).

**Financial and economic barriers** relate to issues of insuring sustainable funding as a guarantee of investment return. These barriers include the issues of establishment and regulation of tariffs and other fees related to WM, and the lack of real economic incentives for the development of recycling (IFC's the World Bank Group, 2010). Weak involvement of waste into economic circulation is explained by, in many cases, the high costs of waste collection and preparation for recycling. It reduces the profitability of recycling or makes it unprofitable for entrepreneurs. Possible economic incentives that could encourage businesses to collect and recycle of waste are very insignificant. It is caused by the relatively low competitiveness of goods produced from waste. Such goods could be even cheap, but ratio "price/quality" for them is less favorable in compare with goods made from primary raw materials (Cleandex Report, 2010a).

***Cultural and information barriers*** are reflected the lack of awareness of environmental friendly WM by the society itself, so that the public demand for good quality is virtually absent. The implementation of effective waste management measures requires a change of attitude from residents' side as well as from government side. It is necessary to develop fundamentally different attitude to the culture of waste management, to design new norms and rules of behavior. The situation in this area is more difficult than, for example, in energy saving in the housing sector, because the consumer is not able to assess the immediate economic benefits in the form of cost savings (IFC's the World Bank Group, 2010). Underdevelopment of separate waste collection in Russia is defined by cultural and information barriers. The lack of public interest in the solution of this problem leads to the fact that even after implementation of pilot projects on environmental education of the population (for example, in Nizhny Novgorod, Smolensk, Belgorod, Volgograd and Moscow), the idea of separate collection does not take roots and spread.

It should be noted that Russia has reach Soviet experience of 1970-80s on the collection and recycling of traditional forms of secondary raw materials based on the territorial principle. The individual elements of the system continue to function in current economic conditions. It could be used for improving MSW management. The experience of local systems for collection and recycling of waste in large Russian cities (Moscow, St. Petersburg and others.) should be developed and disseminated.

Recommendations of improving the solid waste management system in Russia (IFC's the World Bank Group, 2010):

1. Improvement of tariff and fees system, their differentiation depending on the size and stage of waste treatment on the basis of "pay on the fact of waste disposal."
2. Implementation of the principle of extended producer responsibility.
3. Implementation of program-oriented approach with reasonable targets, tight deadlines for achieving them, regular monitoring and adjustments.
4. Responsibility for the implementation of the strategy and action plan (road map) should be assigned to a single authorized state body at the federal level and the level of the Subject of Federation.
5. Implementation of the management model of "single coordination agent" in the territorial plans of MSW management.
6. Improving the system of information and education of the population.

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## 13. Overview of waste management in Kazakhstan

### 13.1 Overall Background

The Kazakh Soviet Socialist Republic, also known by its alternative names of Soviet Kazakhstan and Kazakhstan, was one of the constituent republics of the Soviet Union. It was created on December 5, 1936 from the Kazakh ASSR, and it was an autonomous republic of the Russian SFSR with a capital in Orenburg.

At 2,717,300 square kilometres in area, it was the second largest republic in the USSR, after the Russian SFSR. In February 1925 the capital of the country was moved to Alma-Ata (today known as Almaty). During the 1950s and 1960s the influx of immigrants, mostly Russians, skewed the ethnic mixture and enabled non-Kazakhs to outnumber natives. As a result, the use of the Kazakh language declined but has started to pick up again since independence. The other nationalities included Ukrainians, Germans, Jews, Belarusians, Koreans and others. Germans at the time of independence formed about 8% of the population, the largest concentration of Germans in the entire Soviet Union. Independence has caused many of these newcomers to emigrate.

During its existence as a Soviet republic it was led by the Communist Party of the Kazakh SSR. On October 25, 1990, the Supreme Soviet of the Kazakh SSR declared its sovereignty on its soil. Nursultan Nazarbaev was elected as president – a role he has remained in to this day. On December 10, 1991 the Kazakh SSR was renamed the Republic of Kazakhstan. It became independent on December 16, becoming the last republic to secede before the final collapse of the Soviet Union.

Available data on social, economic and demographic situation in Kazakhstan in 1990 and 1991 is presented in Table 38.

Table 38: Social, economic and demographic situation in Kazakhstan before USSR collapse\*

Indicator	1990*	1991**
<b>Demographic situation</b>		
Population, thous per	16691	16451,7
Life expectancy at birth		
Total	68,8	67,6

Men	64,0	62,6
Women	73,2	72,4
Birth rate (per 1000)	21,7	21,5
Death rate (per 1000)	7,7	8,2
Infant mortality rate (per 1000)	26,4	27,3
Population growth rate (per 1000)	14,0	13,3
Migration net, person		-57686
Average family size	4,0	
<b>Social conditions</b>		
Hospital beds, thous items		230,4
Number of school		8575
Number of schoolchildren, thous per		3147,4
Labor force, thousand persons	6476	
Average monthly incomes, rubles	265,4	
<b>Economic situation</b>		
GDP, mln KZT		85,9
Industrial production, mln KZT		172
Agricultural production, mln KZT		77,8
Investments, mln KZT		47
Retail turnover, bn KZT	21899 (mln rub)	35,0

\* (Economy of the USSR in 1990)

\*\* Data from web-site of Kazakh Statistic agency <http://www.stat.gov.kz/>

Ethnic Kazakhs, a mix of Turkic and Mongol nomadic tribes who migrated to the region by the 13th century, were rarely united as a single nation. The area was conquered by Russia in the 18th century, and Kazakhstan became a Soviet Republic in 1936. During

the 1950s and 1960s agricultural "Virgin Lands" program, Soviet citizens were encouraged to help cultivate Kazakhstan's northern pastures. This influx of immigrants (mostly Russians, but also some other deported nationalities) skewed the ethnic mixture and enabled non-ethnic Kazakhs to outnumber natives. Non-Muslim ethnic minorities departed Kazakhstan in large numbers from the mid-1990s through the mid-2000s and a national program has repatriated about a million ethnic Kazakhs back to Kazakhstan. These trends have allowed Kazakhs to become the titular majority again. This dramatic demographic shift has also undermined the previous religious diversity and made the country more than 70 percent Muslim. Kazakhstan's economy is larger than those of all the other Central Asian states largely due to the country's vast natural resources. Current issues include: developing a cohesive national identity; managing Islamic revivalism; expanding the development of the country's vast energy resources and exporting them to world markets; diversifying the economy outside the oil, gas, and mining sectors; enhancing Kazakhstan's economic competitiveness; developing a multiparty parliament and advancing political and social reform; and strengthening relations with neighboring states and other foreign powers.

### 13.1.1 Country profile

Table 39: General information about Kazakhstan (web-site Index Mundi, n.d.)

Location	Central Asia, northwest of China; a small portion west of the Ural (Zhayyq) River in eastern-most Europe
Area	total: 2724900 sq km land: 2699700 sq km water: 25200 sq km
Land boundaries	total: 13364 km border countries: China 1765 km, Kyrgyzstan 1212 km, Russia 7644 km, Turkmenistan 413 km, Uzbekistan 2330 km
Coast line	0 km (landlocked); note - Kazakhstan borders the Aral Sea, now split into two bodies of water (1070 km), and the Caspian Sea (1894 km)
Climate	continental, cold winters and hot summers, arid and semi-arid
Terrain	vast flat steppe extending from the Volga in the west to the Altai Mountains in the east and from the plains of western

	Siberia in the north to oases and deserts of Central Asia in the south
Elevation extremes	lowest point: Vpadina Kaundy -132 m highest point: Khan Tangiri Shyngy (Pik Khan-Tengri) 6995 m
Natural resources	major deposits of petroleum, natural gas, coal, iron ore, manganese, chrome ore, nickel, cobalt, copper, molybdenum, lead, zinc, bauxite, gold, uranium
Land use	arable land: 8,82% permanent crops: 0,03% other: 91,15% (2011)
Irrigated land	20660 sq km (2010)
Total renewable water resources	107,5 cu km (2011)
Freshwater withdrawal (domestic/industrial/agricultural)	total: 21,14 cu km/yr (4%/30%/66%) per capita: 1304 cu m/yr (2010)
Environment - current issues	radioactive or toxic chemical sites associated with former defense industries and test ranges scattered throughout the country pose health risks for humans and animals; industrial pollution is severe in some cities; because the two main rivers that flowed into the Aral Sea have been diverted for irrigation, it is drying up and leaving behind a harmful layer of chemical pesticides and natural salts; these substances are then picked up by the wind and blown into noxious dust storms; pollution in the Caspian Sea; soil pollution from overuse of agricultural chemicals and salination from poor infrastructure and wasteful irrigation practices

### *13.1.2 Development of economic and environmental situation*

Table 40: Demographic and medical profile of Kazakhstan (web-site Index Mundi, n.d.)

Population	17948816 (July 2014 est.)
Age structure	0-14 years: 25,1% (male 2247628/female 2254744) 15-24 years: 16,1% (male 1469275/female 1418175) 25-54 years: 42,6% (male 3720498/female 3927626) 55-64 years: 9,2% (male 724683/female 935416)

	65 years and over: 7% (male 429565/female 821206) (2014 est.)
Median age	total: 29,7 years male: 28,4 years female: 31,1 years (2014 est.)
Life expectancy at birth	total population: 70,24 years male: 64,98 years female: 75,17 years (2014 est.)
Population growth rate	1,17% (2014 est.)
Birth rate	19,61 births/1000 population (2014 est.)
Death rate	8,31 deaths/1000 population (2014 est.)
Infant mortality rate	total: 21,61 deaths/1000 live births male: 24,34 deaths/1000 live births female: 19,06 deaths/1000 live births (2014 est.)
Net migration rate	0,42 migrant(s)/1000 population (2014 est.)
Urbanization	urban population: 53,6% of total population (2011) rate of urbanization: 0,87% annual rate of change (2010-15 est.)
Mother's mean age at first birth	25 (2011 est.)
Total fertility rate	2,34 children born/woman (2014 est.)
Ethnic groups	Kazakh (Qazaq) 63,1%, Russian 23,7%, Uzbek 2,9%, Ukrainian 2,1%, Uighur 1,4%, Tatar 1,3%, German 1,1%, other 4,4% (2009 est.)
Religions	Muslim 70,2%, Christian 26,2% (mainly Russian Orthodox), other 0,2%, atheist 2,8%, unspecified 0,5% (2009 est.)
Languages	Kazakh (official, Qazaq) 64,4%, Russian (official, used in everyday business, designated the "language of inter-ethnic communication") 95% (2001 est.)
Literacy	total population: 99,7% male: 99,8% female: 99,7% (2009 est.)
School life expectancy (primary to tertiary education)	15 years

Education expenditures	3,1% of GDP (2009)
Health expenditures	3,9% of GDP (2011)
Physicians density	3,84 physicians/1000 population (2011)
Hospital bed density	7,6 beds/1000 population (2009)
Obesity - adult prevalence rate	23,7% (2008)
Drinking water source	improved: urban: 99,2% of population rural: 86% of population total: 93,1% of population unimproved: urban: 0,8% of population rural: 14% of population total: 6,9% of population (2012 est.)
Sanitation facility access	improved: urban: 97% of population rural: 98% of population total: 97,5% of population unimproved: urban: 3% of population rural: 2% of population total: 2,5% of population (2012 est.)

### *Economic situation*

Kazakhstan, geographically the largest of the former Soviet republics, excluding Russia, possesses enormous fossil fuel reserves and plentiful supplies of other minerals and metals, such as uranium, copper, and zinc. It also has a large agricultural sector featuring livestock and grain. In 2002 Kazakhstan became the first country in the former Soviet Union to receive an investment-grade credit rating. Extractive industries have been and will continue to be the engine of Kazakhstan's growth, although the country is aggressively pursuing diversification strategies. Landlocked, with restricted access to the high seas, Kazakhstan relies on its neighbors to export its products, especially oil and grain. Although its Caspian Sea ports, pipelines, and rail lines carrying oil have been upgraded, civil aviation and roadways continue to need attention. Telecoms are improving, but



require considerable investment, as does the information technology base. Supply and distribution of electricity can be erratic because of regional dependencies, but the country is moving forward with plans to improve reliability of electricity and gas supply to its population. At the end of 2007, global financial markets froze up and the loss of capital inflows to Kazakhstani banks caused a credit crunch. The subsequent and sharp fall of oil and commodity prices in 2008 aggravated the economic situation, and Kazakhstan plunged into recession. While the global financial crisis took a significant toll on Kazakhstan's economy, it has rebounded well, helped by prudent government measures. Rising commodity prices have helped the recovery. Despite solid macroeconomic indicators, the government realizes that its economy suffers from an overreliance on oil and extractive industries, the so-called "Dutch disease." In response, Kazakhstan has embarked on an ambitious diversification program, aimed at developing targeted sectors like transport, pharmaceuticals, telecommunications, petrochemicals and food processing. In 2010 Kazakhstan joined the Belarus-Kazakhstan-Russia Customs Union in an effort to boost foreign investment and improve trade relationships. Some economic data is represented in Table 41.

Table 41: Economic situation in Kazakhstan (web-site Index Mundi, n.d.)

GDP (purchasing power parity)	\$243,6 billion (2013 est.) \$231,9 billion (2012 est.) \$220,6 billion (2011 est.) note: data are in 2013 US dollars
GDP (official exchange rate)	\$224,9 billion (2013 est.)
GDP - real growth rate	5% (2013 est.) 5,1% (2012 est.) 7,5% (2011 est.)
GDP - per capita (PPP)	\$14 100 (2013 est.) \$13 700 (2012 est.) \$13 200 (2011 est.) note: data are in 2013 US dollars
Gross national saving	28,8% of GDP (2013 est.) 23,9% of GDP (2012 est.) 28,4% of GDP (2011 est.)

GDP - composition, by end use	household consumption: 51% government consumption: 12,4% investment in fixed capital: 22,1% investment in inventories: 2,5% exports of goods and services: 44,6% imports of goods and services: -32,6% (2013 est.)
GDP - composition by sector	agriculture: 5,2% industry: 37,9% services: 56,9% (2011 est.)
Population below poverty line	5,3% (2011 est.)
Labor force	9,022 million (2013 est.)
Labor force - by occupation	agriculture: 25,8% industry: 11,9% services: 62,3% (2012)
Unemployment rate	5,3% (2013 est.) 5,3% (2012 est.)
Unemployment, youth ages 15-24	total: 3,9% male: 2,9% female: 5,1% (2012)
Household income or consumption by percentage share	lowest 10%: 3,9% highest 10%: 23,7% (2011 est.)
Distribution of family income - Gini index	28,9 (2011) 31,5 (2003)
Budget	revenues: \$43,88 billion expenditures: \$49 billion (2013 est.)
Taxes and other revenues	19,5% of GDP (2013 est.)
Budget surplus (+) or deficit (-)	-2,3% of GDP (2013 est.)
Public debt	15,6% of GDP (2013 est.) 13,2% of GDP (2012 est.)
Inflation rate (consumer prices)	5,8% (2013 est.) 5,1% (2012 est.)

Central bank discount rate	5,5% (31 December 2012 est.) 7,5% (31 December 2011 est.)
Commercial bank prime lending rate	NA% (31 December 2013 est.) 6,6% (31 December 2012 est.)
Stock of narrow money	\$24,51 billion (31 December 2013 est.) \$25,82 billion (31 December 2012 est.)
Stock of broad money	\$70,36 billion (31 December 2012 est.) \$65,71 billion (31 December 2011 est.)
Stock of domestic credit	\$87,05 billion (31 December 2013 est.) \$83,08 billion (31 December 2012 est.)
Agriculture - products	grain (mostly spring wheat and barley), potatoes, vegetables, melons; livestock
Industries - products	oil, coal, iron ore, manganese, chromite, lead, zinc, copper, titanium, bauxite, gold, silver, phosphates, sulfur, uranium, iron and steel; tractors and other agricultural machinery, electric motors, construction materials
Industrial production growth rate	2,1% (2013 est.)
Current Account Balance	\$1,965 billion (2013 est.) \$640,5 million (2012 est.)
Exports	\$87,23 billion (2013 est.) \$86,93 billion (2012 est.)
Exports - commodities	oil and oil products, natural gas, ferrous metals, chemicals, machinery, grain, wool, meat, coal
Exports - partners	China 19,3%, Italy 18,1%, Netherlands 8,8%, France 6,6%, Switzerland 5,8%, Austria 5,8% (2012)
Imports	\$52,03 billion (2013 est.) \$49,08 billion (2012 est.)
Imports - commodities	machinery and equipment, metal products, foodstuffs
Imports - partners	China 28%, Ukraine 10,9%, Germany 8,5%, US 7,9% (2012)
Reserves of foreign exchange and gold	\$29,34 billion (31 December 2013 est.) \$28,28 billion (31 December 2012 est.)

Debt - external	\$131,3 billion (31 December 2013 est.) \$133,5 billion (31 December 2012 est.)
Stock of direct foreign investment - at home	\$123,5 billion (31 December 2013 est.) \$111,5 billion (31 December 2012 est.)
Stock of direct foreign investment - abroad	\$26,53 billion (31 December 2013 est.) \$25,53 billion (31 December 2012 est.)

### Environmental situation

Environmental footprint of Belarus is briefly represented in Table 42.

Table 42: Environmental footprint of Kazakhstan

Year	Carbon dioxide emissions (CO <sub>2</sub> ), kg CO <sub>2</sub> per \$1 GDP (CDIAC)	Carbon dioxide emissions (CO <sub>2</sub> ), metric tons of CO <sub>2</sub> per capita (CDIAC)	Carbon dioxide emissions (CO <sub>2</sub> ), thousand metric tons of CO <sub>2</sub> (CDIAC)	Consumption of all Ozone-Depleting Substances in ODP metric tons	Energy use (kg oil equivalent) per \$1,000 GDP	Terrestrial and marine areas protected to total territorial area, %	Terrestrial and marine areas protected, sq. km.
1990				2355,9	628	2,4	64738
1991				2285,2	722	2,4	64817
1992	2,6752	15,9032	261307		803	2,42	65329
1993	2,493	13,5696	221105	3279,2	736	2,43	65399
1994	2,5735	12,3749	199488		747	2,43	65409
1995	2,343	10,4692	166731		730	2,43	65409
1996	1,9673	8,9549	140692	1739,6	632	2,52	67920
1997	1,7816	8,3705	129581	1541,6	540	2,52	67920
1998	1,7528	8,196	125063	1970,5	549	2,52	67920
1999	1,5898	7,7264	116493	829,6	489	2,52	67957
2000	1,588	8,5426	127769	597,9	501	2,52	67957
2001	1,6197	9,9209	147908	346,2	446	2,52	67957
2002	1,5154	10,179	151946	146,9	440	2,52	67957
2003	1,4035	10,2565	153816	64	439	2,52	67957

2004	1,4333	11,4072	172158	45,5	425	2,52	67957
2005	1,3451	11,6647	177233	40	426	2,52	67957
2006	1,3171	12,5584	192121	79,9	435	2,52	67957
2007	1,4316	14,7585	227402	120,9	419	2,52	67957
2008	1,4441	15,2662	236954	128,8	432	2,52	67957

## 13.2 Waste management situation in Kazakhstan

### *13.2.1 Legal and institutional framework of waste management*

#### **Before 1990**

The main legislative instruments in the field of solid waste management in the USSR are provided in section 11.2.1. There is no information about regulative documents developed directly in KazakhSSR during Soviet times.

#### **After 1990**

Legislation of the Republic of Kazakhstan in the field of WM regulation is based on the Constitution of the Republic of Kazakhstan, the provisions of the Environmental Code and the laws of the Republic of Kazakhstan "On Sanitary and Epidemiological Welfare", "On protection of fauna", the Concept of transition of Kazakhstan to sustainable development for 2007-2024.

Normative legal acts regulated relations in WM:

- Order of the Minister of the Environment of the Republic of Kazakhstan "On Waste Catalogue Approval» №169-p, May 31, 2007;
- Guidelines for the determination of the contamination level of the environmental components by toxic substances of the production and consumption waste (The Order of the Ministry of Ecology and Bioresources of Kazakhstan, August 29, 1997);
- Rules for determination of hazardous waste generated by the activity of the enterprises and individuals to the specific hazard class (The Order of the Minister of

the Environmental Protection of the Republic of Kazakhstan №331-p, December 8, 2005;

- Production and consumption waste: regulatory requirements system (The Order of the Ministry of Ecology and Bioresources of Kazakhstan, December 17, 1993);
- Rules for the development of waste management regulation projects by physical and legal entities and its presentation for approval to the authorized body of Kazakhstan in environmental protection (The Order of the Ministry of the Environmental Protection № 163-p, May 23, 2006);
- Rules for formation of liquidation funds for landfills (№591, July 10, 2007);
- Waste register for disposal at landfills of different classes (The Order of the Acting Minister of environmental protection №244-p, August 2, 2007);
- Guidelines for the development of the project of norms for limiting storage of production waste and consumption waste (The Order of the Ministry of the Environmental Protection № 100-p, April 18, 2008, Appendix 16);
- Guidelines for the calculation of pollutant emissions from landfills into the atmosphere (The Order of the Ministry of the Environmental Protection №100-p, April 18, 2008, Appendix 17);
- Waste import, export and transit regulations (№594, July 11, 2007);
- Building regulation "MSW landfills" (Building regulation of the Republic of Kazakhstan 1.04-15.2002);
- Sanitary rules and norms "Construction and maintenance of MSW landfills" (№3 01.016.97).

The main document in MSW management in Kazakhstan is the Environmental Code of the Republic of Kazakhstan (hereinafter - the Code). The Code includes six chapters (19-20 and 41-44) which are in particular dedicated to WM issues. These chapters cover almost all aspects of WM, as well as stipulate such key principles as the duty of caution compliance, pollution sources and principles of probability. However, most of the statements of the Code are written in general words and have declarative form. The enforcement instruments which are aimed the implementation of regulatory framework are either absent or insufficient. This applies particularly to: planning and administrative responsibility for the development of an integrated waste management system; technical standards on emission and norms in the recycling and utilization of waste; economic initiatives on reducing waste generation at the source; recycling and reuse of waste. The requirements to WM established by the Code could be divided into three parts:

1. environmental requirements to individuals and legal entities should be carried out before waste generation;
2. environmental requirements to individuals and legal entities should be carried out after the waste generation (requirements on waste accumulation, as well as the waste collection, recycling and utilization, deactivation, transportation and storage);
3. environmental requirements to individuals and legal entities should be carried out during landfilling (requirements to landfills, including landfills of hazardous waste, as well as the landfills of radioactive waste).

In accordance with the Environmental Code, provincial, municipal and district self-governmental bodies (*akimats*) are responsible for the collection, sorting, removal, storage and burial, recycling of MSW, as well as encouraging businesses to do recycling. Coordination and organization of activities on area improvement, sanitary maintenance, cleanups and keeping cleanliness in the city are carried out in accordance with the [Rules of improvement, sanitary maintenance of the territory](#).

In addition, there were developed projects of 4 national standards of the Republic of Kazakhstan:

- Standard of the Republic of Kazakhstan "Specialized enterprises for the management of production and consumption waste. General requirements".
- Standard of the Republic of Kazakhstan "Waste. Waste oils and oily waste. Safe management techniques".
- Standard of the Republic of Kazakhstan "Resource saving. Waste management. Accounting and control of the movement of mercury waste. The main provisions".
- Standard of the Republic of Kazakhstan "Electrical and electronic equipment waste. Requirements for handling safety".

The problem of solid waste management is also focused in number of national programs and strategic plans:

- Environmental Safety Concept for 2004-2015;
- National program of environmental protection for 2008-2010;
- Strategic Plan of the Ministry of environmental protection for 2009-2011;
- Sectoral Programme of the Ministry of Environmental Protection for 2010-2014 - "Zhasyl Damu" (Green Development).

Modernization Program for Waste Management System on 2014–2050 was approved by the Resolution of the Government of the Republic of Kazakhstan № 634 in June, 2014. The goals of the program are: 1) improving the efficiency, safety, environmental and social acceptability of range of services for MSW collection, transportation, recycling and disposal; 2) increasing the share of recycled MSW, as well as ensuring the safe disposal of waste (Modernization program, 2014). The achievement of these goals is detected with help of target indicators which are presented in Table 43.

Table 43: Target indicators of Modernization program

Target indicator	Value of the target indicator	
	Year 2030	Year 2050
Coverage by MSW removal service of population	100 %	
Sanitary waste storage	95 %	
Share of the recycled waste	40 %	50 %

The amount of funding for the implementation of Modernization Program in 2014-2050 is 128 424 530 000 tenge, including for the 1st phase (2014-2020):

- republican budget - 884 530 000 tenge;
- local budgets - 52 589 million tenge;
- private investment - 74 951 million tenge.

According to Modernization Program, local executive bodies at the level of cities and regions will carry out the development and implementation of WM policies at the local level, which should be corresponded with national policy and included the following:



- Inclusion of the activities for modernization of MSW sector into programs of territorial development;
- Planning of investment in facilities involved in WM;
- Collecting, reporting and analyzing data on waste;
- Development of educational and informational programs on WM for the population.

Furthermore, local executive bodies will be customers of WM services with the functions:

- Development of operational plans to achieve the target indicators;
- Preparation of tender documents, evaluation and signing agreements on WM;
- Monitoring of the commitments according to the contracts;
- Coordination and implementation of corrective measures;
- Implementation of EPR: to sign the agreements with producers and importers of packaging and products, to keep a register of producers, importers and volumes of produced and imported goods and packaging, to accumulate transferred money and to make funds, to organize the waste collection and recycling at the expense of these funds.

At the national level the Ministry of Energy of the Republic of Kazakhstan organizes the main stages of MSW management, develops and implements WM policy. According to the Regulation on the Ministry of Energy and the Resolution of the Government (September 19, 2014 № 994) the functions of central national agency are follow:

1. develops and implements National policy, controls the rational use of natural resources and manages MSW;
2. develops typical regulations for calculating the norms of generation and accumulation of municipal waste;
3. organizes maintenance of the State Cadaster of industrial and consumption waste and makes an annual informational review;
4. organizes the methodological support of MSW management;
5. organizes applied researches and R&D activities on MSW management;
6. establishes the list of waste for disposal at the landfills of different classes.

The Committee on Statistics writes down the informational report based on statistical observation data on waste types and regional specific of MSW management (Report about sorting, 2015).

Main drawbacks of MSW management in Kazakhstan are (1) the lack of established institutional infrastructure of MSW management, (2) the disunity of territories over MSW management, (3) the lack of common sound policy on WM. In order to solve the existing problems in the sector there is a need in implementation of regional approach for the entire WM process: from separate collection "at source" to the landfilling the inert part of solid waste at landfills.

There are drawbacks in the tariff system for municipal services on waste removal and landfilling. The current methodology for the calculation of tariffs includes only payment for MSW removal, and it does not include the payment for waste collection, recycling and landfilling. Analysis of the current legal framework allows us to make the following conclusions: for enterprises it is more profitable to pay for waste disposal, than to make efforts on waste utilization and use. So, the Environmental Code of Kazakhstan provides economic incentives for separate collection and waste recycling, but it is not applied in practice (Ecological Code, 2007).

The weak point is the waste management is an enforcement of developed and approved documents. According to experts (Separate collection..., 2012), "the state programs and projects are developed and approved, but so far everything remains at the document level. For example, the draft of law "On Waste" was developed and submitted to the Parliament in 2004, but it has not yet been adopted".

Key issues of institutional governance in the field of MSW management in Kazakhstan are: the lack of the development of regulations and legislation in MSW management, weak enforcement of approved documents, high level of bureaucracy and inertness of governmental bodies with right on legislative initiative, the lack of transparency of distribution of power and responsibilities, overlapping of functions of different institutions at different level of governance.

13.2.2 Development of waste management situation and infrastructure**Before 1990**Data and its availability

Data on MSW management in Kazakhstan during Soviet times is not available.

General scheme of municipal waste management

Scheme of MSW management in the KazakhSSR was the same as in the whole of the USSR: food waste was separately collected; glass, waste paper and scrap of ferrous and non-ferrous metals were collected as secondary resources. All rest waste (mix waste) was transported to landfills. Only waste treatment plant (for composting) was in operation throughout the whole KazakhSSR.

MSW generation

Currently there are no data available.

Waste composition

The study of the morphological composition of MSW was carried out for the organization of waste treatment. Information about the morphological and chemical composition of solid waste is presented in Table 44 and Table 45 respectively.

Table 44: Morphological composition of MSW (Sanitary cleaning..., 1990)

Component	Content,% by mass
Paper, cardboard	20-28
Food waste	35-45
Wood	1-2
Ferrous metals	0,5-2
Non-ferrous metals	0,2-0,3

Textile	4-7
Bones	1-2
Glass	3-6
Leather, Rubber	1-3
Stones	1-2
Plastic	1,5-2,5
Other	1-2
Screenings (less than 15 mm)	10-18

Table 45: Chemical composition of MSW (Sanitary cleaning..., 1990)

Component	% of dry mass
Organic matter	56-80
Ash content	20-44
Total nitrogen	1,2-2,7
Calcium	4-5,7
Carbon	28-39
Phosphorus	0,5-0,8
Total potassium	0,5-1,1
Sulfur	0,2-0,3
The reaction medium pH	5-6,5
Humidity,% of the total mass	40-70

#### Waste collection and transportation, landfilling and treatment

MSW collection, transportation, landfilling and treatment were carried out in accordance with scheme described in section 11.2.3. There is no data on removed municipal waste, number of landfills and amount of stored waste in KazakhSSR.

#### Recycling

The system of collection of recycled materials was described in the section. There is no data on collected recyclables and their use in KazakhSR.

## **After 1990**

### *Data and its availability*

The monitoring of municipal waste is carried out according to two statistical forms:

- 1-waste "Report on the collection and removal of municipal waste";
- 2 waste "Report on waste sorting, utilizing and depositing".

An annual bulletin "On the collection, removal, sorting and depositing of municipal waste" is published on the basis of the forms mentioned above. Bulletin is not available in Internet.

However, the Statistics Agency of Kazakhstan reviews the forms with the participation of all interested parties on an annual basis. In 2013 form 2-waste has been included a new section "The volume of municipal waste intended for treatment by species: food waste, paper, cardboard, glass, plastic, household and electronic equipment, metal, tires, wood, clothing, textiles". The revision is carried out in accordance with the questionnaire on implemented measures in the waste statistics (Kazakhstan survey..., 2013). At the website of Statistic Agency of the Republic of Kazakhstan there is no data on this section of bulletin.

"Norms" of MSW accumulation per capita have a wide range from 80 to 400 kg/person per year at the regional level. The statistics implies the existence of inconsistencies in data collection and reporting.

Currently, in the Republic of Kazakhstan there is not any accounting of the generation and collection of hazardous household waste.

### *MSW generation*

The total amount of accumulated MSW in Kazakhstan is about 100 million tons. About 5-6 million tons of solid waste is generated per year. By 2025 this figure could rise up to 8 million tons. Dynamics of MSW generation in total and per capita is shown in figure 52.

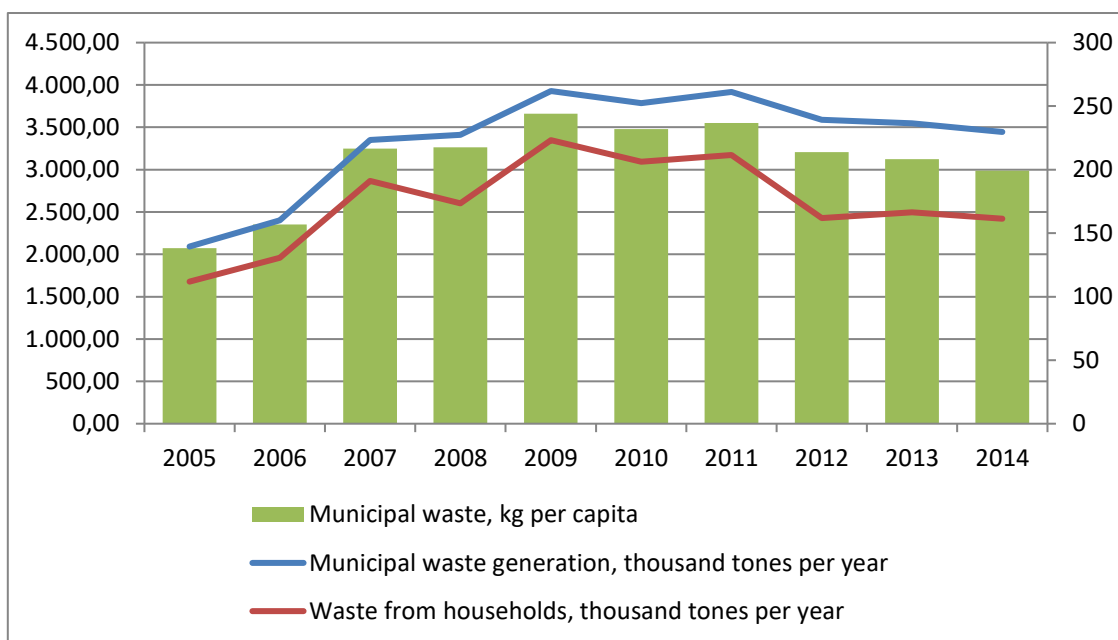


figure 52: Waste generation in Kazakhstan \* based on statistic data  
<http://www.stat.gov.kz/>

It should be noted that the situation with municipal waste differs in urban and rural areas. In urban areas the main MSW generators are not only households but also enterprises and organizations. So, in 2012 it was generated about 3,7 million tons of solid waste, about 75-80 % of which was generated in households and, consequently, about 20-25 % of waste was produced by legal entities (companies and organizations) in urban areas. In rural areas the main MSW generators are households. The share of MSW generation in rural areas in the total volume in Kazakhstan is about 30 %, which is equivalent to 1,5 million tons in 2012 (Modernization program, 2014).

### Waste composition

Table 46 is provided the morphological composition of MSW at urban areas based on results of analysis in 9 cities of Kazakhstan in 2011 made by company «Fichtner».

Table 46: Morphological composition of MSW in Kazakhstan (Modernization program, 2014)

Component	Share, %
Food waste	37
Paper and cardboard	25

Plastic	15
Glass	6
Textile	6
Rubber	3
Metals	3
Wooden waste	3
Other	2

Morphological composition of MSW at rural and urban areas is different. At rural areas organic waste dominates in morphological composition, and share of plastic, package, paper are less than in MSW at urban areas. It should be noted, that at rural areas organic waste is not usually landfilled. The significant part of organic waste is fed to kettle or composted at households. In addition, wooden waste is burned for heating. These activities impact on morphological composition and generated amount of MSW (Modernization program, 2014).

#### Waste collection and transportation

At present time in Kazakhstan separate collection of MSW “at source of generation” is not carried out. Mixed waste is collected in containers and is transported to MSW landfills. MSW generated at multi-story housing area is collected at special container sites. Containers are installed by owners of apartments. In many cases, installed containers have different sizes, which impacts on loading system of waste cars and reduce their efficiency (Report..., 2010). At low-story housing area MSW in plastic bags put near households for further collection by waste cars.

According to the requirements of sanitary-epidemiological service, MSW removal should be carried out at least twice a week in the area of low-rise buildings, and at least three times a week in the area of multi-story housing, in the central part of the city- on a daily basis. Weekly monitoring of enterprises for MSW disposal is carried out by experts of the Office of the State Sanitary and Epidemiological Surveillance (Report..., 2010).

Removal of accumulated MSW is carried out by enterprises-contractors on the basis of state order agreement. Removal of bulky waste is carried out by companies and individuals themselves or enterprises-contractors according to signing contract. Legal entities

and owners of private households must sign contracts on MSW removal with enterprises-contractors. Service on collection and removal of MSW is provided by companies of different forms of ownership (Table 47). Over last 4 years the number of service companies has decreased dramatically, which (according to local experts, (Separate collection..., 2012) inks to the unprofitability of such activities.

Table 47: Companies provided service on MSW collection and removal

Indicator	2011	2012	2013	2014
Number of companies provided service on MSW collection and removal	482	424	411	368
Depends on the ownership, %:				
Public	45,6	23,1	14,4	14,2
Private	52,5	75,5	85,6	85,8
Foreign	1,9	1,4	-	-

Cars for collection of MSW are outdated, worn and do not meet established requirements (Report..., 2010). Public access to the services of MSW collection and disposal is acceptable only in large cities. In small towns and rural areas there are the lack of these services and poor quality of services (Modernization program, 2014).

### Sorting MSW

There are no waste-transferring (sorting) stations in Kazakhstan. System of separate collection of MSW "at source of generation" is not developed. Sorting is carried out at MSW landfills directly. As a rule, the garbage at all dumps is separated by hand. The chance to work at the landfill is not free. People separate recyclables which are carefully weighed by representatives of recycling companies at the end of working day. Plastic bottles are handed over to the recyclers by KZT35 for 1 kg, and glass, only bottle, separated by color - KZT2-3 for 1 kg (Report..., 2010). Another example. Until recently in the city of Aktobe part of waste has been utilized by a small company «PolyEcoProject». About 70 people on a daily basis went to municipal landfill, collected glass bottles, plastic material, polyethylene, mattresses and cushions. By 4 p.m. they quitted the landfill and sold all collected wastes to people who came to buy them. PolyEcoProject had its



own scrape plastic grinder and melt granulator. Their product was demanded by 10 enterprises which fabricate paving tiles, hatch covers and tiles. At present, only very insignificant part of MSW is treated (Table 48).

Table 48: Sorting and treatment of MSW in Kazakhstan

Indicator	2011	2012	2013	2014
Collected and removed MSW, total mln t	3,9	3,6	3,5	3,427
From it, %:				
Sorted	0,88	-	0,53	0,4
Transported for treatment	-	-	0,48	0,2
Recycled	1,76	4,89	0,58	11,18
Transported for landfilling	97,36	95,11	98,41	88,22

#### Recycling and treatment

On the basis of the averaged morphological composition, the quantity of SRM in MSW is about 500 ths tons of paper waste, 300 ths tons of glass, 200 ths tons of metals, 500 ths tons of plastic (Modernization program, 2014). At present time, the volume of utilized and recycled MSW is not significant (Table 49).

Table 49: Recycling and secondary use of MSW in Kazakhstan

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
MSW, ths tons per year	2 091,9	2 401,2	3 351,8	3 411,9	3 928,3	3 784,7	3 919,3	3 588,3	354 7,7	3446 ,3
Processing and recycling of them, ths tons per year	8,5	13,4	22,3	101,3	151,2	71,1	64,3	136,5	16,0	383,0
Processing	0,4	0,6	0,7	3,0	3,8	1,9	1,6	3,8	0,5	11,1

and re-cycling of them, %										
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Currently, recycling and utilization are not licensed, that why special registration and accounting of recycling plants are not provided (Interview, 2015). According to the Committee on Statistics, about 500 recycling companies are resisted in Kazakhstan. Almost all of them are located in Almaty.

There are few large recycling plants for MSW in Kazakhstan. The largest one is "Altyn-TET" which is operating in Astana from 2012. Plant is sorting and recycling mixed MSW. The plant capacity is 250-300 ths tons per year (700-750 tons per day), the recovery of waste is 7 %. Pressed remains (93 %) are transported to landfill (National report, 2015). The volume of MSW recycling reached in Kazakhstan is provided by SME recycled some types waste: waste paper, plastic, glass, medical waste, non-ferrous metals, used tires, lead-acid batteries, mercury-containing products and devices (National report, 2015).

Recycling of waste paper is the most developed sector of WTP. The sector is represented by large Almaty companies ("Kagazy Recycling", "Karina") as well as "Pavlodarski cardboard and ruberoid factory", the cardboard factory "Koktas-Aktobe", "EcoLifeBatys" in Aksai (Waste from home, 2014). Plastic and polymer processing is less developed industry, but, nevertheless, is represented in Kazakhstan. Only few companies are engaged in this activity: "Vtorma Ecology" and "KazVtorsyre" in Almaty, as well as "Ibraikhan and K-LTD" in Kyzylorda. Only glass factory "SAF" in Almaty treats waste glass (Waste from home, 2014). Some manufacturers stimulate collection of packaging of their own products. In particular, it concerns the beverage manufacturers which take back their empties for the purpose of the following recycling. Also, collection of plastic containers is often done for import in the neighboring countries for recycling, but this is not regulated legislatively and carried out spontaneously.

The huge issue is a utilization of hazardous waste from population. There is no centralized system of collection hazardous waste from population (it links to galvanic batteries, lead-acid batteries, WEEE, medical and vet waste, household chemicals. Mainly, these types of waste are landfilled together with mixed MSW. There is an unregulated and spontaneous market on the collection and primary processing of used lead-acid batteries, household appliances and electronic devices with the aim of extracting non-ferrous and precious metals. Spontaneous turnover of batteries and WEEE is not significant.

Recently, the market on recycling of used tires has got a small development. It relates to approving (in 2013) of recycling standard established the requirement to treat all used tires. At the moment, used tires are recycling in Almaty ("PromTehnoResurs"), in Astana ("Kazkauchuk"), and in Shymkent ("ECO Shina"). There was unsuccessful experience: the plant "Kazakhstan Rubber Recycling" started up in 2009 in Astana was stopped very soon and offered for sale. Astana could not provide the plant with sufficient quantity of raw materials, but delivering raw materials from other settlements was considered by owner as unprofitable measure (Waste from home, 2014).

The situation with the mercury-containing municipal waste is specific. In particular, the system of the collection of mercury vapor (fluorescent) lamps from organizations and institutions and mercury thermometers from medical institutions with the purpose of the following processing them (demercurization) is well-developed. There are at least 16 plants process and/or recycle the mercury-containing waste. 8 plants provide demerurization. At the same time the system of collection of mercury-containing waste form population is not developed, and in many cases this waste gets into the main flow of MSW (Modernization program, 2014).

At present there are no centralized incineration and biological treatment plants. The first pilot project on construction of the mechanical and biological treatment plant is proposed for implementation in Aktau. The beginning of construction of WTP was arranged for 2014.

In the cities of Kazakhstan the construction of recycling plants continues. In 2013 in Shymkent of the South Kazakhstan Region MTP "Tekhnologii 21" with capacity of 200 ths t/yr was started. At present the plant carries out only sorting of MSW, the recovery is 12 % (National report, 2015). In 2014 in Zhanaozen of the Mangystau Region a plant for processing, utilization and burial of MSW with capacity of 50 ths t/yr and recovery of 86 % was set to operation (National report, 2015). In Kostanay, by 2017, a plant for processing glass, plastic, paper and metals with planned capacity of 100 ths t/yr was arranged to set to operation. Moreover, systematic waste processing is planned to start in Pavlodar in 2016 (Waste from home, 2014).

The Government of Kazakhstan spends huge money on construction of WTP. According to the Minister of Environmental Protection and Water Resources Nurlan Kapparov 1 bn tenge were assigned for building WTPs in 2013; and 8 plants are under construction at expenses this money. In next 10 years, 41 WTP will be built throughout the Republic (Waste from home, 2014). However, there is a risk that not all plans will be fully imple-

mented. The history of Kazakh recycling has such sad experience. Almaty WTP considered as one of the largest plant in the CIS was in operation only 2 years (Problem..., 2015). Due to indebtedness of the company «VtormaEcology» to a bank, operation of WTP (built in 2007 with capacity of 450 ths t/yr) is stopped and the banks accounts are attached. At present the plant doesn't work (National report, 2015). Recycling enterprises meet with difficulties, the main of which are: the lack of systematic separated waste collection; low efficiency of sorting and processing at landfills (Waste from home, 2014), which lead to stoppage of recycling. So, according to an *akimat* of Almaty, there are 25 companies engaged in collection and processing of waste: paper, batteries, mercury - containing waste, textile, metals, used tires and others rubber containing waste, glass, plastic and polyethylene. At the same time a lot of them have not already worked (Separate collection..., 2012).

### Landfilling

At present the landfilling is the main method of permanent waste disposal in Kazakhstan. In the Ecological code all landfills are classified into 3 classes: the 1-st class – for storage of hazardous waste; the 2-d class –for storage of non-dangerous waste; the 3-d class – for storage of MSW. As a rule, the mentioned requirement for waste disposal at landfills with different danger class is not implemented. Generated waste is removed to landfills without preliminary sorting and neutralization. Landfilling of MSW at landfills is carried out by follow way: garbage is received at daily area, distributed and compacted by a self-propelled roller up to 2 meters; and then covered by soil to prevent the waste form scattering and smelling. It should be mentioned that in practice at all MSW landfills in Kazakhstan there are no weighting machines in the waste receiving areas, i.e. the tonnage is calculated by converting cubic meters into tons, and the value of unit weight varies from 250 to 300 kilogram per cubic meter.

Waste disposal objects are often difficult to call MSW landfills, because in many cases they as a matter of fact are illegal disposal sites (the share of "legal" landfills is small, see Table 50). In October of 2015 the situation became worse: there are 4284 of landfills and dumps. From this number the legal landfills and dumps met environmental requirements and sanitary standards and provided with all necessary documentation are 459 (National report, 2015).

Table 50: MSW landfills in Kazakhstan (Abdinov et al., 2011)

Region of Kazakhstan	Number of settlements	MSW landfills			"Norms" of land-filling in 2009, ths t	De facto landfilled waste in 2009, ths t	Total volume of MSW at landfill, ths t
		Total	Legal	Legal, %			
Akmola Region	641	521	14	2,7	101,07	132,8	3463,5
Aktobe Region	410	470	5	1,1	178,45	617,53	8877,8
Almaty Region	772	513	6	1,2	376,9	829,9	8710,3
Atyrau Region	154	9	6	66,7	130,29	46,94	2553,3
East Kazakhstan Region	592	442	50	11,3	225,78	455,2	7906,9
Zhambyl Region	344	209	3	1,4	12,15	79,15	2960,92
West Kazakhstan Region	478	469	121	25,8	96,36	99,08	2895,5
Karaganda Region	325	212	15	7,1	613,26	503,97	5095,52
Kostanay Region	640	461	163	35,4	585,76	447,69	2011
Kyzylorda Region	158	137	4	2,9	48,4	97,6	809
Mangystau Region	19	6	6	100,0	211,62	209,29	624,82
Pavlodar Region	412	276	4	1,4	36,09	625,07	5953,89
North Kazakhstan Region	719	611	2	0,3	80,42	367,86	2046,42
South Kazakhstan Region	857	287	135	47,0	8,42	170,28	2843,96
Astana city	2	2	2	100,0	622,44	407,77	1342,7
Total	6523	4625	536	11,6	3327,4	5090,1	58095,5

In practice, all landfills are out of expiration date, needed in recultivation, in collection of landfill gas (on the assumption of economic feasibility), as well as construction of new regional landfills is necessary. Today, except Astana landfill, no one MSW landfill meets environmental requirements and sanitary standards (Modernization program, 2014). In the field of landfilling next typical discrepancies in Kazakhstan are: (1) 1) the lack of synthetic or clay impervious screen at the majority of the waste disposal objects; 2) widespread disposal of MSW together with industrial, medical and others types of toxic and hazardous waste; 3) unsystematical compaction and interleaving of the stored waste with isolated layer (clay) or the lack of it; 4) the lack of system for collection of filtrate and landfill gases (including methane); 5) excessive usage of many landfills and dumps which exceed their capacity; 6) lack of the monitoring of dumps; 7) discrepancy of requirement of sanitary rules and sanitary protection zone (National report, 2015). The lacks of MSW sorting system by population, as well as the lack of special sites for separate collection and large distance to landfill lead to increasing of illegal landfills (Modernization program, 2014).

### 13.2.3 Legal and economic instruments to support waste management hierarchy

#### Before 1990

See section 11.2.3. It should be noted that during the Soviet era in the Kazakh Soviet Socialist Republic several successful experiments were implemented to stimulate the collection of SRM from the population. In particular, annual plan of economic and social development was included tasks for departments of trade on special amount of goods (of high demand among people) provided for collecting points of recyclables. Special conditions for such goods were established: price of goods should not exceed a certain value per unit (no more than 5 rubles) or that 50 % of the market fund of lids for canning, toilet paper or other specific products should be sold through point-stores (Zakharov et al., 1980).

There were three special department stores in Alma-Ata where in addition to the common trade was offered to sale goods in accordance with confirmation from collecting points of recyclables. The advantage of this process, on the one hand, is that people can take SRM to the collecting point regardless of the availability of the required commodity;

on the other hand, in the case of lack of demand in specific commodity, the store could offer it to free sale (Zakharov et al., 1980).

### **After 1990**

Initial data for planning of the number of recyclables is “norms” of accumulation of municipal waste. They are calculated in accordance with the Model Rules on calculation of “norms” of generation and accumulation of municipal waste, appr. by Order of the Minister of Energy of the Republic of Kazakhstan from 25.11.2014, № 145. In accordance with the rules, the calculation of “norms” of generation and accumulation of municipal waste is carried out in accordance with field measurements and further assessment of volume at the one unit.

Modernization program, as was mentioned above, was approved in Kazakhstan. Orders of Minister of energy “On the development of criteria for selection of projects for modernization of WTP”, “Plan of information promotion actions in the field of WM” and etc. were adopted (National report, 2015). In 2014 for management of ownerless hazardous waste more than 99 million tenge were spent. The interventions are carried out in Aktobe, Karaganda and Kostanay regions (National report, 2015).

Local executive authorities may destablish the measures for stimulation of recycling and reducing waste generation (Environmental Code Article 297). Local executive bodies are trying to attract investment for the construction of facilities for sorting and recycling of solid waste. An interdepartmental working group under the Ministry of Energy was organized for the purpose of consultations with international financial institutions, donors, private sector on financing of MSW projects. Also, within the framework of a partnership agreement between the Government of Kazakhstan and international financial development institutions, are implemented projects in the field of MSW management (National report, 2015). Investment rationale for 9 cities (Aktobe, Atyrau, Karaganda, Kokshetau, Kostanay, Pavlodar, Taldykorgan, Taraz, Ust-Kamenogorsk) were developed (National report, 2015).

### 13.2.4 Waste management system financing

#### Before 1990

Art. 20.1 of the Environmental Code provides that the tariffs for the collection, removal and disposal of waste, as well as norms of waste generation and accumulation are established by local executive authorities.

Pricing in public services remain outside of state regulation. Subjects in these services, under current legislation, are required only to notify the public body of the impending increase in the tariff (Report..., 2010) The basis for the calculation of tariffs is MSW accumulation norm. Norms are reviewed at least 1 time in 5 years and are approved by local executive authorities. After registering the new norms of waste generation and accumulation at the Justice Department, experts of local department of HPU could calculate new prices for the removal and disposal of waste, which are also approved by local executive authorities.

Tariffs on services of solid waste disposal are formed on the basis of the planned prime cost (standard cost) for the removal of 1 cu. meter of solid waste, all kinds of established taxes and level of profit needed for the accumulation of funds for the purchase and updating containers and cars, taking into account the norms of MSW generation in m<sup>3</sup> per person. Prime cost is calculated in accordance with the Methodology of calculation of tariffs for the collection, transport and disposal of MSW, appr. by Order of the Minister of Energy of the Republic of Kazakhstan from 15.01.2016, № 10. According to the procedure, the full cost of services is calculated as the sum of costs for execution of works for the collection, removal and disposal of solid waste, as well as general operating and external costs.

Tariffs are set up for 1 person; they are different in each region, as well as their dynamics of growth. Moreover, tariffs may vary within the borders of settlement, despite the same norms of MSW accumulation, and depend on service company and the type of housing area. For example, company JSC "Tartyp", covering 45 % of the market in Almaty, the monthly payment in 2009 for improved housing area was 187,77 KZT per 1 person, and for un-improved housing area was 207,77 KZT per 1 person (Report..., 2010) Service companies desire to increase norms of waste generation, in order to rise the fee for service. Almost all cities are revised norms of waste generation and accumulation due to cost-justified complaints by service companies which do not want to work "for free"



(Report..., 2010). Sometimes it takes the form of open confrontation between business and self-governmental bodies (see., for example, Tariff approved legitimately, <http://flashpress.kz/blog/flash/107884.html>).

Market studies of municipal services showed (Report..., 2010), uniformity in the local tariffs policies.

Utilities market studies have concluded (Report..., 2010), that formation of tariffs there. In some cases, the environmental component (for waste landfilling fee) is included in the tariffs for waste landfilling, in some cases is not included. The same is true for non-regulated tariffs for waste disposal. It should be clarified that the fee for the disposal of waste at the landfill (fee for the reception of waste) is a payment for services rendered by the enterprises - owners of landfills. The fee is intended to compensate the landfill operating costs for waste disposal at the landfill. Relationships on landfilling is governed by civil law, the recipient of payment - the owner of the landfill. The tariff for waste disposal at the site can not be equated to "environmental" fee for storage of industrial and consumption waste, but can include it. Similarly, the environmental fee may already be included in the tariff for the removal and disposal of waste, under which the Management Company pays to company transported waste. This sort of "re-nomination" of fee for waste disposal to customer, which the company transported waste pays the landfill according to approved tariffs for waste disposal by regulatory authority.

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Management Company pays to company transported waste. This sort of "re-nomination" of fee for waste disposal to customer, which the company transported waste pays the landfill according to approved tariffs for waste disposal by regulatory authority.

### 13.2.5 Public awareness, education and communication initiatives

#### **Before 1990**

See in section 11.2.5.

#### **After 1990**

As one of the most pressing issues for Kazakhstan is to organize separate collection of waste at the source of generation, the vast majority of initiatives are somehow connected with this issue. The leader, of course, is Astana. In Astana in 2015 a pilot project started to implement separate collection of MSW at source of its generation. The capital's residents of 36 houses should separately throw out paper, plastic and mixed waste. More than 50 container sites have been already equipped with colored boxes (yellow for plastic, blue for paper, green for mixed waste (National report, 2015). In addition, a pilot project on the separate collection of ash from homeowners will be implemented with the installation of 300 special containers in the private housing area. Earlier, in 2013, a pilot project on collection of energy-saving mercury-containing lamps was implemented with installation of 167 special containers at container sites. In 2014 additionally 130 such containers were established. During the period of the project implementation from the public was collected and disposed more than 900 thousand lamps (National report, 2015).

In 2012-2014, the Center "Supporting of Sustainable Development" implemented the project "Public awareness on the implementation of separate collection of waste in the Republic of Kazakhstan." Astana, Karaganda, Petropavlovsk and Borovoye were involved in the project. Leaflets and booklets about the promotion of separate collection were developed during project implementation. It was developed and filmed social video on the separate collection of waste for demonstration on TV (Satubaldin, 2015).

Action "Separating waste you preserve nature of Kazakhstan!" was held in Karaganda educational institutions. The action was attended over 15 000 pupils among 13 schools. During the implementation of the action lectures were held by volunteers in 17 schools, with a total participation of 1934 of students and teachers (Satubaldin, 2015). The result of project work of the Center " Supporting of Sustainable Development " was the development of a Model Leaflet on separate waste collection for population. Al-Farabi Kazakh National University and the Republican Public Association "Kazakhstan National Geographic Society" are going to apply the elements of the Model Leaflet under the social project on development of "green offices" at educational institutions (Satubaldin, 2015).

In 2015, project on separate collection of WEEE was started with support of UNDP (Separate collection..., 2012).

In Kazakhstan, with the support of international financial institutions are implemented several projects related to the construction of WTPs. According to the program of joint economic researches together with EBRD project applications on construction of recycling plants in Almaty and Kyzylorda are preparing (National report, 2015).

### 13.2.6 Barriers and success factors for waste management performance

#### Before 1990

See in section 11.2.6.

#### After 1990

Strengths and weakness of MSW management system in Kazakhstan is represented in Table 51.

Table 51: Barriers and success factors for WM in Kazakhstan

Strengths	Weakness
<p>Approved policy in the field of MSW management</p> <p>Huge investments (national, international) into recycling sector</p> <p>Involving private business into WM sector</p> <p>Implemented public and communication initiatives aimed to change behavior model of waste generators</p>	<p>Underdeveloped system of separate collection of municipal waste “near place of generation”</p> <p>Landfilling as a main strategy of dealing with waste</p> <p>Lack of treatment facilities</p> <p>Non-compliance of existing landfills to environmental requirements</p> <p>Lack of centralized and unified policy of pricing for waste</p>
Opportunities	Threats
<p>Favorable investment climate</p> <p>Implementation of a regional approach to MSW management system</p> <p>Huge development capacity for because start point is equal to 0</p> <p>Best practices and international experience are available in organization of effective MSW management</p>	<p>Occurrence of critical environmental situations in the areas of accumulated waste</p> <p>Use of the country as a repository for hazardous waste by neighbors</p> <p>Block of economic and political relations with partner countries, including the “freezing” of relations with EU and the USA</p> <p>Political instability in Central Asia</p>

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## 14. Waste management situation in Ukraine

### 14.1 Overall background

Ukraine is the largest state located in Eastern Europe boarded by Belarus to the north-west, Poland, Slovakia to the west, Hungary, Romania and Moldova to the southwest, and Russia to the east and northwest. The Black Sea and the Sea of Azov wash thsouth and southeast of Ukraine (figure 53).



figure 53: Geographical map of Ukraine

The territory of Ukraine is subdivided into 27 regions of which 22 Oblast, the City of Kyiv with special status, and the temporarily occupied territories of two Oblast (Luhansk and Donetsk) and the Autonomous Republic of Crimea and Sevastopol which are still recognized as the Ukrainian territory by the majority of the international community. The territories of Oblasts are subdivided into 479 rayons and city municipalities of Oblast significance or the second-level administrative units. The settlements in Ukraine are referred to the urban or rural category.

Total present population of Ukraine as of January 1<sup>st</sup>, 2016 is 42 760 500 of which almost two third is living in the urban area excluding the temporarily occupied territories of the Autonomous Republic of Crimea, and the city of Sevastopol (figure 54). [1]

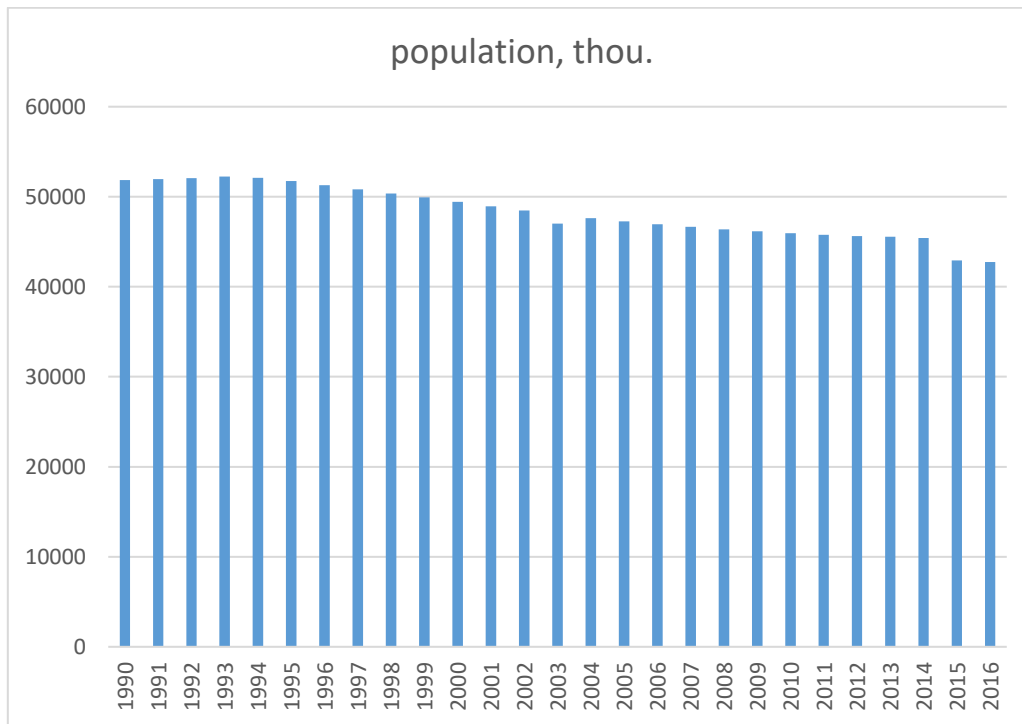


figure 54: Demographic situation in Ukraine in 1990- 2016

The independence of Ukraine was declared on August 24<sup>th</sup>, 1991. After declaration of the independence, Ukrainians decided on the European direction of its political and economic development.

Review of the economic indicators of Ukraine since its independence shows that the country does not fully use its potential. The state has the great access to the international markets being located quite beneficially from the geographic point. It has the worlds' biggest area of fertile agricultural lands. Moreover, the Ukrainian population is intelligent, the country also has the deserved comparative advantage in the metallurgical sector as well as other industries and technological fields. In 1990s, the economic situation in Ukraine experienced deep recession and the highest rate of poverty among population but after several years of stable development in the beginning of 2000s the Ukrainian economy firstly evidenced its growth. In 2008, the situation in the country was significantly affected by the world economic crisis: the national currency was devaluated from 5 to 8 UAH for 1 US dollar, the unemployment rate increased up to 9 %, Ukraine's

GDP fell by 15% in 2009. The Ukrainian economy started its recovering together with other states in 2010 due to the recovery of the world economy and increasing prices for metals. During the period from 2010-2014 the economic situation in Ukraine remained problematic mainly due to the absence of the effecting reforming, corruption at all levels of authorities, signification portion of business operating in shadow (approximately 40%). The further restoration of economy was slow and almost completely stacked due to the corruption policy of the Yanuckovich's government. By the time, substantially sensitive economy got worse in 2014 due to the annexation of the Crimea and support of the separatists' movement in Donbass by Russia. This year GDP also reduced by 6.8% comparing to the same period last year. The general unstable situation caused the outflow of the capital and immediate fall in exchange. By that time tranches from the International Monetary Fund, political support from European countries and the USA, sanctions against the Russian Federation contributed to the stabilization of the situation in Ukraine.

Nowadays the European Union (EU) remains one of the main partners of Ukraine that is interested to maintain and develop the strong, predicted, transparent and open relations. Since 1998, Ukraine cooperated with EU within the framework of Programme of Ukraine's Integration with the EU. In 2014, after the revolutionary movement and overthrow of the precedent Government, Ukraine signed the Ukraine–European Union Association Agreement aiming at the profound integration between Ukraine and the European Union in the spheres of politics, trade, culture, and strengthen security, replacing the previous Agreement on Partnership and Cooperation between the European Communities and Ukraine. Implementation of the Association Agreement will cause the reforming of most vital spheres of economy and politics of Ukraine, provide significant opportunities for the set of additional benefits for Ukraine, including inflow of the foreign investments but it also sets the tasks which Ukraine should achieve in order to become the full member of the EU. These tasks include the approximation of legislation of Ukraine in different spheres to the European one, including the legislation aimed at the environmental improvement and efficient municipal solid waste management (MSWM).

The current practice of waste management in Ukraine has the increasing negative impact on the environment and human health, ineffective use of material and energy resources. Ukraine annually generates about 400 mln. tonne of waste (354 803 000 in 2014) [1], including 348 383 500 tonnes of the waste generated by the different economic activities and 6 419 500 tonne of waste from the households and similar waste (figure 55).

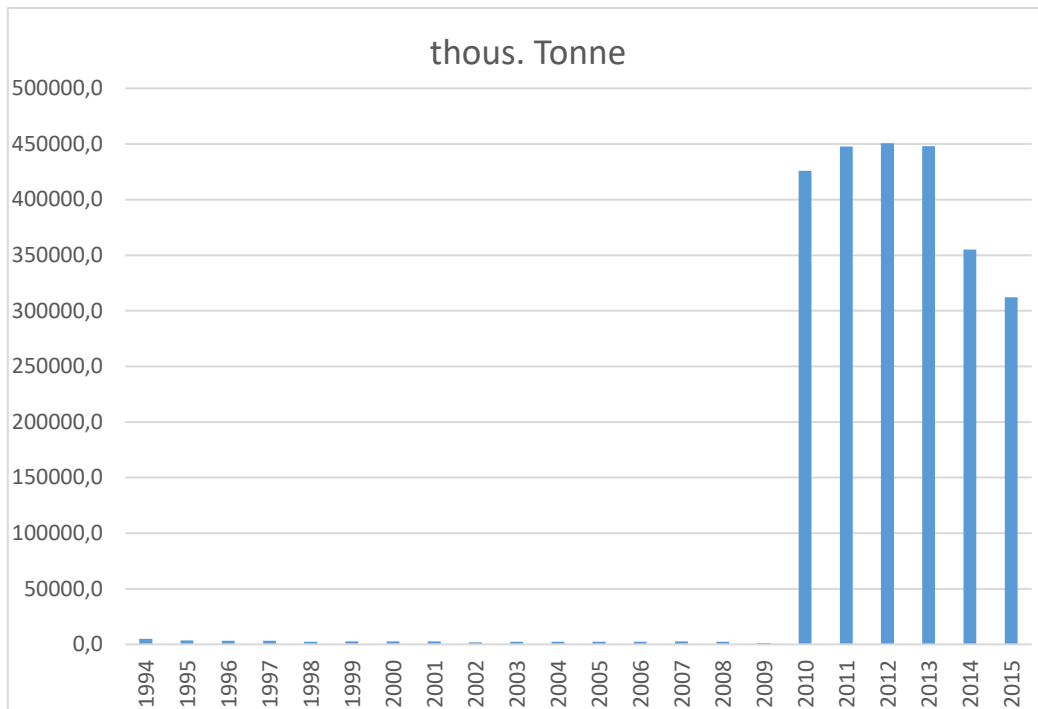


figure 55: Waste generation in Ukraine in 1994- 2015

Despite the small share of municipal waste in the waste structure, the effective functioning of this sector is extremely important, as it directly influences the state of the environment in the places where people live. In addition, recycled waste is an additional source of raw materials and energy for the national economy.

The volume of municipal waste generation in Ukraine has a tendency to grow, despite the decline in population. The rate of generation of waste is growing at 4-5% per year. [2] The structural composition of solid waste is the determining factor in the formation of the waste management system. The qualitative composition of waste specifies requirements for a system of collection and treatment. The significance of this figure increases dramatically when choosing methods of recycling of municipal waste. Unfortunately, the composition of MSW system studies in Ukraine has not yet been conducted. The only source of statistical information are micro-studies being conducted by operators and associations for different regions at different times. Their conclusions differ significantly and prove the necessity to develop the profound and overall approach to the MSWM in compliance with the European legislation.

By 1997, the total amount of waste on Ukraine's territory exceeded 25 billion tonnes, which corresponds to approximately 40 000 tonnes per square kilometre. Only a fraction of this waste, less than 10-12 per cent, is recycled; the rest is disposed of at surface dumps or accumulated in sludge ponds, refuse heaps, ash storage sites, etc. The total

surface of these sites has reached 160 000 ha. On the whole, Ukraine is one of the biggest waste generators and accumulators.

In Ukraine there is no effective system of environmental monitoring, state regulation in the sphere of waste management is imperfect. A rapid and uncontrolled accumulation of industrial and household waste is a threat to the national interests and national security of Ukraine.

The regulations and standards of the former Soviet Union remained in force at the time of independence and are gradually replaced or amended by new laws and regulations. In addition, some new legislative norms that are relevant to waste management have been introduced. The major problem with both policies and legal instruments is their implementation. Even those old legal instruments that are still valid are not fully and properly implemented, and there is a wide discrepancy between policy intentions and ambitions on the one hand, and the realistic possibilities for implementing them on the other.

The most significant step in the development of a new legal framework for waste management was the adoption of the new Law on Wastes (5 March 1998). The main provisions of this Law relate to the reduction of waste generation and accumulation, the stimulation of waste recycling, and environmentally safe waste disposal. It addresses principles and general aims, as well as generic approaches to the issues of waste management.

Based on the reports of the Statistic Services of Ukraine, Ministry of the Regional Development, Construction, Housing and Municipal Economy, Ministry of Ecology and Natural Resources as well as the international organizations Ukraine annually produces up to 12-13 million tons of waste of which only 3-8 % are recycled while the remaining waste goes directly to the landfills and dumps. In Ukraine, there are more than 6000 known landfill and dumpsites most of which are adolescent, do not comply the sanitary norms, overloaded and even dangerous for workers at them.

In this situation, Ukrainian government is taking the steps to improve the situation approving new regulatory legislation in compliance with the EU standard. Nevertheless, the economic situation in Ukraine, ongoing war with Russia, social crisis due to mass of the internally displaced people, increased tariffs and reduction of social benefits financing require more urgent actions comparing to waste management measures. Generally speaking, lack of financing, absence of additional resources prevents Ukrainian government from fully implementation of the planned activities but nevertheless, the threat

which implies the landfills, dumpsites and poor waste management on the human health require the immediate action and solutions to be taken. For this purpose, the executive authorities in the waste management sphere applied to the Green Economy Programme (GIZ) to assist in elaboration of all-Ukrainian waste management strategy which could help to tackle the problem and create the basis for legal activities in the waste management sphere. Development of such a national waste management programme is the mandatory measure under the action plan for implementation of Association Agreement. The signing of the Association Agreement EU - Ukraine has opened up new opportunities for the development of new standards in various spheres of public life, including environmental protection in general and waste management, particularly. The implementation of the Agreement requires substantial reform of Ukraine's environmental legislation. In contrast to the modern environmental legislation of Ukraine, which in many respects is a declarative one, the sources of EU law define quantitative and qualitative indicators to be achieved in each country for a certain period of time and / or fully define the procedure. Thus, Directive 2008/98/EC on waste introduces measures to protect the environment and human health by preventing or reducing the negative impacts of production and waste management, as well as reducing the overall impact of the use of resources and improving the efficiency of their use. The implementation of the Directive will substantially change the waste management system in Ukraine, starting with their classification and criteria that will convert waste into the category of by-products (when waste is no longer considered waste). This approach will create a legal framework for strengthening the capacity of waste management practices such as a separate collection, recycling, etc.

#### 14.1.1 Country profile

Ukraine is located in the south-eastern part of Europe, in the East European Plain. The territory of the country within the framework of its constitutional structure is 603 628 km<sup>2</sup>, which corresponds to 5.7% of the whole territory of Europe and 0.44% of the world. Ukraine lost its actual control of the Ukrainian peninsula of Crimea and a part of the Donetsk and Lugansk Oblast in 2014. Almost the entire territory of the Crimea is de-facto controlled by Russia (as the Crimean Federal District), and certain areas of the Donetsk and Lugansk regions are de-facto controlled by the self-proclaimed "DNR" and "LNR". The territory of Ukraine has dimensions of 1316 km from west to east and 740 km from north to south.

Ukraine is located in zone of pine and mixed forests, forest-steppe and steppe. The grey forest and sod-podzolic soils are located to the north of the black earth zone under mixed forests, the dark brown and chestnut soils under the dry steppes - to the south. Forest zone includes a variety of mixed and deciduous forest with white fir, pine, beech and oak, oak forests in the forest-steppe zone, and the steppe zone is characterized by different herbals and ribbon plantations.

The terrain of the most territory of Ukraine is flat: lowlands occupy 71%, and the hills and mountains - 26% and 3% respectively. Mountains are located in the south-west (the Ukrainian Carpathians, the highest point is the Mount Hoverla, 2061 m above sea level). The main lowlands: Black Sea Lowland in the south, Polesian Lowland in the north, the Dnieper Lowland in the centre, and Transcarpathian to the west. In southern Ukraine, in the Kherson region there is one of the largest sand areas in Europe - Oleshky Sands.

The length of the coastline of the Black Sea within the Ukrainian borders is more than 1 500 km. The sea coastlines in Ukraine is mostly flat (except of the Crimean Mountains). The water temperature in winter near the coast is from 0° to +8 °C, in summer it reaches +25 °C. The coastline of the Azov Sea is low, straight and with the typical sand spits. The sea is shallow and near-shore waters freeze during the winter season. The water temperature in summer is +25° – +30 °C. Ukraine also has more than 73 thousand rivers and 20 thousand bodies of waters.

The territory of Ukraine is located in the moderate continental climate with warm and long summer period. The climate is winter differs in region: mild winter is typical for the southern and western parts of Ukraine while in the north and east it is the coldest.

Given the geographical position of Ukraine and different level of its exploration by population, the environmental situation in the country varies in different regions but with overall tendency to deterioration mainly due to the expansion of the economic activities. The main problems in the country relates to increase of green gas emission, deforestation, air and water pollution by industrial and municipal waste, consumption of fresh water. Since the end of the 20th century Ukrainian government participates in and implements a number of the different national and international programmes aiming at the protection of the environment from the harmful effect of the industrial, agricultural and human activities. The protected areas cover 14.63% of land and 2.98% of marine territory. The most polluted cities and regions around them are: Donetsk coal basin and iron-ore basin, Chornobyl area, Volyn Oblast (amber mining sites), Kyiv, Kharkiv, Odessa. The major budget revenue industries are iron and metalworking industries, chemical

industry, agriculture, food production, woodworking industry and the sphere of the services provision.

Approximately 10 million tonnes of municipal waste were generated in Ukraine in 2015 (excluding data from Crimea and Sevastopol) and disposed at 6000 of dumpsites and landfill with the overall area of 9000 ha. 4000 tonnes of household and similar waste were recycled, more than 2500 tonnes were burnt and 6233 tonnes were disposed at the specialized places of facilities. The summary table with the waste by categories collected annually is provided at the web-site of the Ukrainian Statistic Service [3] based on the information submitted by the local authorities to the Ministry of Regional Development and Housing Municipal Economy in the form 1-TPV "Report on solid household management" No 308 as of 19.09.2016. This form is the obligatory for submission by the legal entities and enterprises operating in the sector of the municipal waste management, including waste collection and transport, waste recovery and / or recycling and disposal.

To extract recyclable materials and exclude the hazardous waste containing in the household waste, and to improve environmental situation the separate waste collection was lunched in Ukraine in 2004 and as of 01.01.2016 in 521 settlements the system is being implemented but its efficiency is relatively low mainly due to the lack of the measures to inform and train the local inhabitants. The Ministry lobbies for the implementation of the extended producer's responsibility and effective packaging waste collection as the additional source of the funds for the overall household waste management improvement. In addition, combining financial and administrative resources of the community will stimulate for construction of facilities of household waste management, including inter-municipal landfill of household waste according to European standards while closing and reclamation of old waste dumps.

Meanwhile the provided data requires the additional verification. Reliable information about the volume and composition of generated municipal waste in the settlements ensures effective planning and management, including collection, transport, disposal, use and safe to remove them. However, since 1991, the comprehensive research on the morphological composition of waste was not carried out in Ukraine with the exception of some cases in the framework the different international projects implemented in cooperation with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Swiss-Ukrainian project "Decentralization Support in Ukraine", Partnership for Local Economic Development and Democratic Governance Project and others. Such technical assistance projects together with the international experts provide the support to the Ministry of



Regional Development, Construction and Housing and Municipal Economy to elaborate the development strategy for the household waste management in regions in compliance with the European and international standards. The general situation in the sector is characterized by the high-level monopoly and necessity of comprehensive reforming and de-monopolisation what is possible to achieve only through elaboration and adoption of the relevant laws and legislation.

#### 14.1.2 Development of economic and environmental situation

Severe shocks, combined with a backlog of structural reforms, resulted in a serious economic crisis in 2014-2015. The economy has been hit by unprecedented double shocks from the conflict in the east of Ukraine and a considerably weaker external environment, including lower global commodity prices.

Real GDP contracted by 6.8 percent in 2014 and by a further 10 percent in 2015. The currency depreciated sharply in 2014-15, while the consolidated fiscal deficit, including Naftogaz, reached 10.1 percent of GDP in 2014 and public and guaranteed debt spiked to 82 percent of GDP in 2015. The banking sector experienced deposit outflows, rising levels of nonperforming loans, and large numbers of bank failures.

Decisive reforms have helped to stabilize the economy, reduce large imbalances, and cushion the impact of the shocks on the population. Key reforms adopted with the support of the international community included: moving to a flexible exchange rate; undertaking significant fiscal consolidation; reforming energy tariffs and strengthening the social safety net system; stabilizing the banking sector by putting in place the framework to resolve and recapitalize banks and strengthen supervision; streamlining the business environment; making public procurement more transparent; putting in place external verification of financial disclosures.

Economic prospects remain weak and the fiscal outlook remains challenging, raising the urgency of reforms to unlock growth and manage medium term imbalances. The global economic environment remains weak, the conflict in the East continues despite de-escalation, and a large backlog of reforms remains. As a result, a very gradual economic recovery is expected, with growth of 1-2 percent in 2016 and 2-3 percent in 2017.

The poverty rate (under US\$5/day in 2005 PPP) is estimated to have increased from 3.3 percent in 2014 to 5.8 percent in 2015, while moderate poverty is estimated to have increased from 15.2 percent in 2014 to 22.2 percent in 2015.

Going forward, fiscal consolidation will require restraint on growth of public-sector wages, pensions, and other social programs, which will affect household purchasing power across the income distribution. More effective service delivery can not only reduce expenditure pressures, but also improve labour market outcomes, while improving targeting of social transfers can also help better support incomes of the poor and bottom 40 percent.

Ukraine will need to simultaneously advance reforms on multiple fronts to achieve sustainable recovery and shared prosperity going forward. As the economy has begun to stabilize and large imbalances have been reduced at least for the short term, Ukraine now needs to also address the deeper structural bottlenecks and governance challenges that have constrained sustainable development for the last decade and half. [4]

Meanwhile the environmental problems in Ukraine today have the same urgent need to be solved at the national level. One of the most serious problems is the problem of recovery and recycling of various wastes. During 2015, more than 11 000 000 tons of household and similar waste of I-IV class of hazard were collected. However, the sharp environment protection problem is its treatment of household waste. The specific indicators of generation of waste are, in average, 220—250 kilograms per year per one person and in large cities they reach 330—380 kilograms per year respectively. Solid household waste is mainly disposed on approximately 6000 waste dumps and landfills with a total area of about 9 thousand hectares and only about 3,5 per cent of solid household waste is incinerated on two waste incineration plants in the cities of Kyiv, Dnipropetrovsk and Kharkiv Oblast. Under the estimates about 0.1 percent of household waste are hazardous. [5]

The system of the biogas extraction is applied at 12 landfills, including 7 landfills where the gas is flare-burnt and 5 with the cogeneration facilities. These facilities are installed at the landfills in Vinnitsya, Uzhhorod, power station in Zhytomyr and 2 in Kyiv Oblast. In March 2015 the communal enterprise of Bila Tserkva (Kyiv Oblast) and LNK, Ltd. signed the contract for provision of degasification of the landfill.

Comparing to the situation in 2010 when only 52 settlements had the separate household waste collection, following the report as of 01.01.2016 the separate household waste collection was introduced in 521 settlements.

As of 01.08.2015, 23 sorting lines are installed at landfills in 15 settlements. The sorting line in Chuhuiev, Kharkiv Oblast was launched in 2015; 22 waste sorting complexes are

being under construction in Ukraine. Annual recyclables generation is 1 million m<sup>3</sup>. Processing waste to obtain alternative fuel (RDF, Flaff etc.) for the substitution of coal is carried out on cement plant in Rivne. [6] Another waste processing complex and biogas extraction facility are planned to be built in Odesa Oblast.

## 14.2 Waste management situation in Ukraine

In the centrally planned economy of the former Soviet Union, waste management did not sit high on policy agenda. The Soviet Union generated large amounts of waste but failed to manage them in an appropriate manner. Significant amounts of radioactive waste, chemical weapons, toxic missile fuel and other hazardous waste were stored in mines and at industrial and military facilities. Almost entirely, municipal waste was disposed of at poorly managed landfills or in city dumps that lacked basic sanitary and environmental provisions. Public awareness of waste issues was low, and there was no attempt to describe the cost of waste.

At the same time, there were some positive aspects of the Soviet system with respect to waste management. Firstly, the generation of household and municipal waste and, especially, packaging waste was much lower than in most developed countries. Secondly, the rates of car ownership, and consequently the number of end-of-life waste vehicles, were also much lower. Thirdly, systems were in operation to recycle paper and ferrous metals as well as reuse glass bottles. Many materials were also reused and recycled in households. The quantities of waste generated in EECCA countries (Eastern Europe, Caucasus and Central Asia) decreased somewhat during the 1990s, although this was largely a result of the economic crisis rather than of an improved policy approach. Many of the existing reuse and recycling systems stopped functioning. Since the recycling industries no longer received sufficient quantities of materials and were not competitive in the newly opened international marketplace, many of these companies went out of business. After the break-up of the Soviet Union, large amounts of waste no longer had 'an owner' and many industrial and military sites were abandoned with large stockpiles of hazardous waste. Due to the economic recession and increasing decentralisation, most municipal waste management equipment has not been replaced since the early 1990s. The development of waste management strategies and regulations, and the progress made in municipal waste planning have all been slow. Waste was not — and is still not — regarded as a significant threat to the environment and human health, nor is it perceived as a potential source of valuable resources [7].

Although there was no waste management law in the Soviet Union, the waste production, use, utilization and treatment issues were regulated by the law on nature protection. Almost all Soviet Republics adopted such laws. Besides there were sanitary-hygiene norms and rules addressed the transportation, disposal, utilization or treatment of certain types of wastes (industrial and toxic wastes). There was also strict control over radioactive waste. The management of municipal wastes was organized, being under responsibility of local authorities. In late 1980s, the general inventory of industrial wastes was made in the Soviet Union and the statistical forms for industrial waste reporting were developed. However, the system was never introduced widely, due to the break-up of the Soviet Union.

Soviet Ukraine together with other fifteen republic formed the part of the Soviet Union with the common legislative framework, laws and principles related to every sphere of life including the environmental protection and particularly the waste management sector. In the course of last 25 years, the economic and political situation in Ukraine has undergone the significant changes, however, it is impossible ignoring the experience generated in the waste management sphere in 1970-1980s.

Essentially, the issue of solid waste was treated as an afterthought for which little provision was made and for which few people were prepared to take responsibility. Of all the threats to the environment in the region, solid wastes, and particularly hazardous wastes, were the least documented. Despite the magnitude of the problem, the issue of solid waste disposal has not commanded the level of public attention that other environmental issues, such as water and air pollution, have received. Reporting on waste disposal in the media largely has been limited to stories about the discovery of illegally dumped hazardous wastes. One reason may be that unlike the United States or western Europe, most of the territory of the former Soviet Union has huge expanses of open space that provide great opportunities to conceal discarded wastes, making the problem less visible to the public than other forms of environmental pollution. Government officials themselves often reveal their lack of knowledge of the generation and fate of solid wastes, as appropriate data have not been collected.

Given the lack of available data, it remains impossible to say conclusively how much waste the region's economies produce, how it is treated, or where it is disposed. According to a 1988 estimate by economist Nikolai Pirogov, a USSR Gosplan official responsible for recycling programs, the generation of solid wastes from all sources was approximately 9 billion tons annually. This estimate probably included all forms of waste—from domestic and commercial waste to wastes from industry, agriculture, and

mining. The most comprehensive official information published on solid wastes concerns common household waste. Because of the slow pace of innovation and the otherwise much-criticized neglect of the consumer goods and service sectors of the Soviet economy, the USSR did not experience an explosion of waste from surplus goods, elaborate packaging, and disposable products. Indeed, persistent shortages of such basics as paper, glass, plastic, and even food promoted a tradition of conservation at the individual level. Basically stated, consumers did not have much to waste. As a result, the Soviet economy produced an average of only 56–57 million tons of domestic and commercial waste a year in the late 1980s, or about 195 kilograms of waste per capita. Output ranged widely within the USSR—according to one report, from 160 to 240 kilograms per capita.

#### *14.2.1 Legal and institutional framework of waste management*

##### **Before 1990**

The USSR did not have the certain law to regulate the waste management sector. The sets of the national standards, requirements and rules were used to regulate the activities in this sphere. The first regulating document which stated the national concern due to the waste was the Decree of the Council of Ministries on Measures Ensuring Disposal and Recycling on the Waste Transferred to the Dumpsites dated 26.12.1952 N 1661. Starting from this moment, the Government of USSR elaborated and introduced hundreds of regulatory acts, guidelines, decrees and programmes to ensure the efficient waste collection and management. The main authorities for regulating and controlling any activities in the sector were Gosplan of USSR and Gosnap of USSR. A program-oriented planning and regulation of the level of the waste processing were widely used. The whole territory of the USSR was covered with the specialized infrastructure to collect and process the recyclables. The high costs of “non-profitable” recyclable collection were compensated through inclusion of these costs into cost item of the products of the relevant industry.

In 1986 the general provision was introduced according to which the producer was responsible for elaboration of the technology for re-use of its products or recycling once it is no longer possible to use. The regulation of the waste sector was provided based on the norms and requirements which formed the part of the general environmental

protection legislation and which had been used by Ukraine during several years after getting its independence.

### **After 1990**

The main regulatory instrument governing the waste management in Ukraine is the Law on Waste dated 05.03.1998 No 187/98-VR. It defines legal, organizational and economic principles of activities related to the prevention or reduction of generation, collection, transport, storage, sorting, recovering, recycling and disposal, decontamination and disposal of waste produced in Ukraine, transported through its territory, taken out of it, transportation, processing and disposal of waste imported to Ukraine as a secondary raw materials as well as the prevention of the negative impact of waste on the environment and health human. This Law does not apply to relations in the sphere of animal by-products not intended for human consumption.

The legal framework of waste management in Ukraine also includes the following laws:

- Law on Environmental Protection
- Law on Provision of sanitary and epidemiological welfare of the population
- Law on Radioactive Waste
- Law on Metal Scrap
- Law on Housing and Municipal Services
- Law On the chemical sources of the current
- Law On Veterinary Medicine
- Law on Exclusion, Treatment, Recycling, elimination or further the use of low-quality and dangerous products
- Code of Ukraine on Mineral Resources, and other regulations

The main objectives of the legislation on waste are:

- a) defining the basic principles of state policy in the field of waste management;
- b) legal regulation of relations on the activities in the field of waste management;

- c) determine the main conditions, requirements and rules on environmentally safe waste management, and system of measures related to organizational and economic incentives resource conservation;
- d) ensure minimum waste generation, expanding its use in business, prevent harmful impact of waste on the environment and health man.

The main principles of state policy in the field of waste management is a priority the protection of the environment and human health from the negative impact of waste, ensuring economical use of raw material and energy resources, science-based harmonization of environmental, economic and social interests of the society about the generation and use of waste in order to ensure its sustainable development.

The main measures of state policy to implement these principles include:

- a) ensuring full and timely collection and disposal of waste, as well as compliance with the rules of environmental safety when dealing with them;
- b) minimization of waste and reduce its danger;
- c) providing comprehensive use of raw material resources;
- d) promotion of the highest possible waste disposal by direct re-use or alternative resource of waste;
- e) ensuring safe disposal of waste that are not for disposal through the development of appropriate technology, environmentally friendly methods and means of waste management;
- f) monitoring the organization or facilities of waste disposal to prevent their harmful effects on the environment and human health;
- g) implementation of complex scientific, technical and marketing research to identify and determine the resource value of waste with a view to their effective use;
- h) promotion of the establishment of waste treatment facilities;
- i) ensuring social protection of workers in the field of waste management;
- j) mandatory accounting of waste based on waste classification and certification;
- k) creation of conditions for separate collection of waste by introducing social and economic mechanisms to encourage the creators of these wastes in their separate collection;
- l) promotion of the involvement of private investment and other non-budget sources of financing in the field of waste management.

### **Overview of main WM institutions, and their responsibilities**

The new Law on Wastes is the first attempt at organizing waste management in a comprehensive manner. Prior to its existence, there were no structured institutional responsibilities. The practices of waste management at the various levels of government were largely unknown.

The institutional framework and the responsibilities of the various players are primarily described in chapter IV of the Law on Wastes (“Competence of bodies of executive power and bodies of local selfgovernment in waste management”).

In accordance with Article 22 of the Law on Waste, the specially authorized executive authorities in the field of waste management are the Ministry of Environmental Protection and Natural Resources and its local agencies, the State Sanitary and Epidemiological Service and the Ministry of Regional Development, Construction and Housing and Municipal Economy.

The Ministry of Environmental Protection and Natural Resources is the main authorities responsible for state policy elaboration in the waste management sector and supervision of its implementation with regards to compliance to the environmental legislation.

The main responsibilities of the Ministry of Environmental Protection:

1. coordinating the work of other authorized executive authorities in the field of waste management and monitoring of compliance with environmental safety
2. establishment in accordance with the law the procedures of operations in the waste management
3. participation in the development and approval of regulations governing waste management
4. conclusion of agreements based on the Law’s provisions of interagency international treaties of Ukraine on cooperation in the field of waste management and control of transboundary movement of waste
5. information exchange with the authorities of other countries and international organizations in the field of waste management
6. approval of the list of dangerous features of waste in coordination with the central executive body that implements the state policy in the field of sanitary and epidemiological welfare of the population.



The central executive body that ensures the state policy in the field of environmental protection, performs other functions provided by law.

The Ministry of Regional Development, Construction and Housing and Municipal Economy perform the controlling of the local authorities' activities.

Main responsibilities of the Ministry of Regional Development include:

1. state policy formation in the sphere of household waste management, ensuring the development of state programmes in the waste management sphere, plans and measures in the field of household waste management
2. coordination of local authorities in the waste management sector
3. regulatory and methodological support for the waste management
4. development and approval of state standards, rules and regulations in the field of solid household waste management
5. approval of programs in the sphere of waste management
6. establish in consultation with the central executive body that ensures the state policy in the sphere of environmental protection and the central executive authority, which provides public policy in the field of sanitary and epidemiological welfare, procedure development, coordination and approval of schemes of sanitary cleaning of settlements
7. approval by the agreement of the central executive body that ensures the state policy in the field of environmental protection, rules of operation and maintenance of facilities of household waste management
8. other powers provided by the laws of Ukraine.

The State Sanitary Service has the following functions with regards to the waste management in Ukraine:

1. identify priority actions to protect human health from the negative impact of waste on the public health
2. state sanitary expertise of design estimates to determine the locations and feasibility of construction projects, expansion, reconstruction of waste management facilities
3. issuing conclusions of the state sanitary expertise on waste treatment facilities

4. establishing sanitary requirements for products produced from waste and issuing hygienic certificate for them
5. methodological support and control in the determination of the level of hazard of waste
6. coordination of programs in the field of waste management
7. other functions provided by laws of Ukraine.

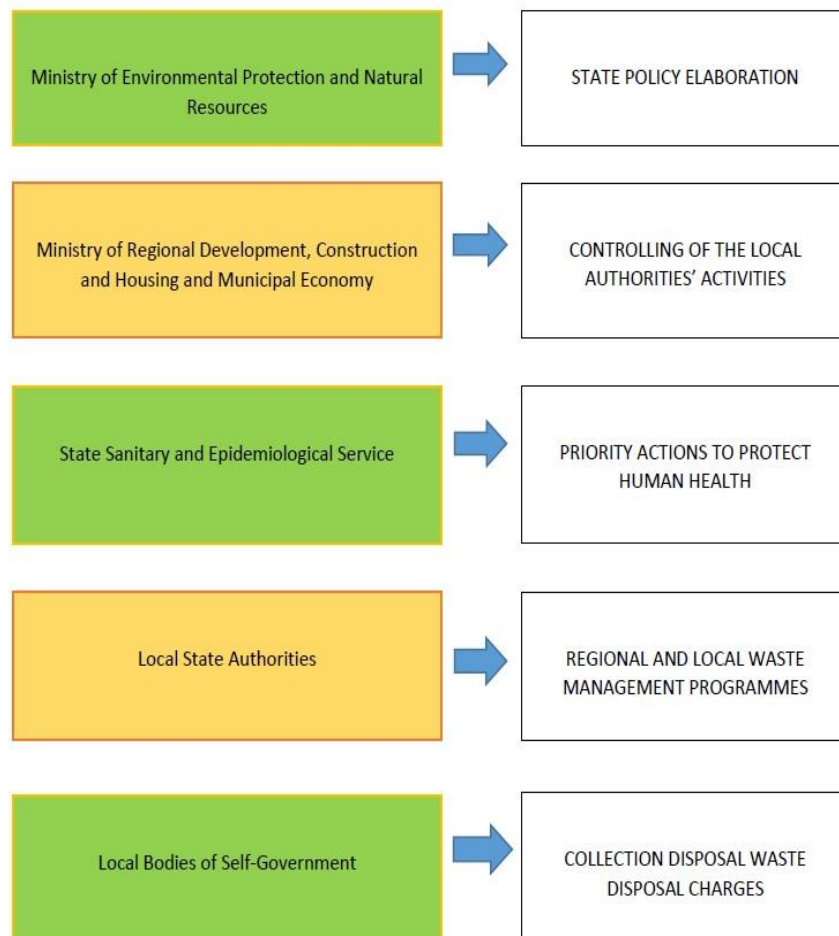


figure 56: Institutional framework of waste management in Ukraine

The local State authorities develop and introduce regional and local waste management programmes, as parts of national programmes. They coordinate and promote the development of business activities in waste management, and control the activities of waste management facilities. They also create and maintain records, and set up registers for the generation, treatment, use and disposal of wastes.

Local bodies of self-government are responsible for: collecting and disposing of domestic wastes; resolving issues dealing with the siting of waste management facilities; establishing waste disposal charges in accordance with legislation; supervising the efficient use and safe waste management; eliminating unauthorized and uncontrolled waste dumps.

The Law on Wastes broadly follows the distribution of responsibilities that has existed until now. However, subsidiary legal acts, good administrative procedures and sufficient budgetary means will be needed to ensure that the various authorities can live up to their responsibilities.

### **Overview waste management actors**

Waste market in Ukraine is a complicated and non-perfectly organized structure but the one which has been operating for a long time and regulating the relationships between different actors. The structure is not the common for the whole country but in most cases it has the similar actors.

The main “actor” at the local level is the executive authorities that are responsible for organizing the sanitary cleaning of the territory through announcing the tender for the service supplying and controlling their activities. The companies that provides the services can be either privately-owned or municipal one. These companies serve the population and commercial sector of the municipality. Their main functions include collection and transportation of the waste to the landfills. In some regions it is also possible to find the companies dealing with the waste recycling. Usually these are the private small enterprise focused on plastic, paper or rubber recycling. It is important to note that at the waste market in Ukraine there is largely presented the group of informally involved people engaged into sorting the household waste. They usually extract such recyclables as paper, glass and plastic of poor quality and small value after being mixed with other household waste but still used by the private recycling enterprises.

Landfills are the traditional mode of the waste processing in Ukraine. The owners of the landfills are another “actors” at the Ukrainian waste management market. They are subordinated to and controlled by the local self-governmental bodies.

Several bodies are also performing the controlling and supervision functions at the different stages of the waste treatment. They are the local police department, local sanitary service and epidemiological services (figure 57).

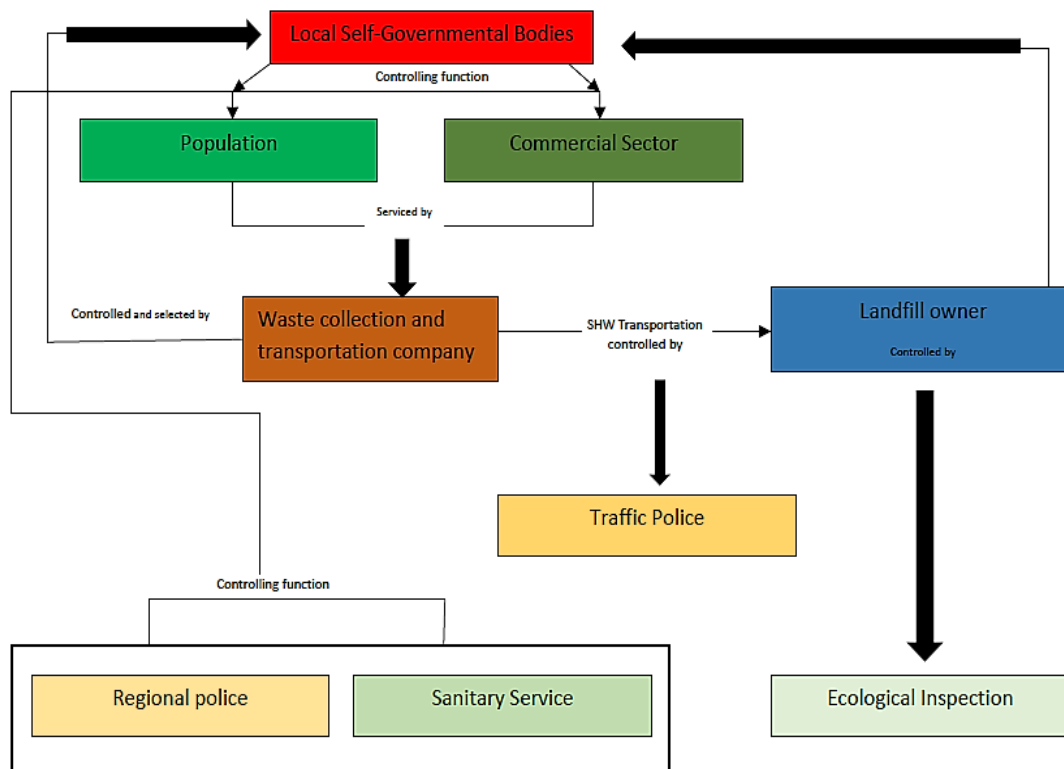


figure 57: Main waste management market actors Ukraine

#### 14.2.2 Development of waste management situation and infrastructure

##### Before 1990

In USSR the significant attention was devoted to the waste recycling. For these purpose before 1990 the Gasplan had the system of the accounted and used recyclables. It was believed that the recyclables use is the potential source of the resource saving. To ensure the efficient scientific and technological support in resource saving the specialized institute of the recyclables had been functioning within the Gosplan of the USSR. The standard bottles were developed for milk and cold beverages; the nationwide centres for glass collection were introduced in the countries. Students and members of the pioneer organizations were involved into paper and metal scrap collection. Precious metal use in the industries, particularly in electronics, was also controlled and accounted. The food waste from households and commerce was carefully collected and was added to the feed for animals at the farms.

To arrange and control these process there were four structures of the national and local level such as:

- The Ministry of the Light Industry was responsible for waste collection in cities and settlements;
- Centrosoyuz – agricultural area;
- Ministry of the Iron Industry and Ministry of Nonferrous Metal Industry – waste collection from industries; farms.

By 1990, USSR had one of the most advanced system of the waste management. The government managed to introduce a number of technological lines for collection of paper, textile, polymeric and wooden waste, used tyres, glass, oils etc.

In 1980s, Gosnab of USSR controlled more than five thousand collection centres of the recyclables from population, including almost two thousands of mobile collection centres. The state policy in the waste management sphere envisaged the high increase of waste recycling. The special state programme of USSR envisaged increase of recyclables' use for more than twice in the period from 1986 until 2000.

Moreover, in 1980s in Ukrainian SSR 4 waste-to-energy plants in Dnipropetrovsk, Kyiv, Yalta, Kharkiv were launched with the total capacity of approximately 5,500 tons per day.

#### **After 1990**

The problems of storage and disposal of solid waste appear and need to be addressed in every civilized country over the last three centuries and the situation in Ukraine is not exceptional. Currently in Ukraine the number of waste as well as landfills and dumpsites is increasing, the sanitary conditions of the settlements are getting worth. Existing waste management practices in Ukraine are resource-inefficient and result in negative environmental impacts. While EU Member States recover, on average, up to 60 percent of MSW, Ukraine's waste recovery rate is no more than five to seven percent. If this trend continues, Ukraine will need to double its MSW disposal capacity in 10 to 15 years.

Dynamics of the waste generation in the country according to the State Statistics Service of Ukraine shows tendency to increase the absolute volume in waste generation and accumulation. In 2013, the rate of waste generation amounted to 448.1 million tonnes (representing 106.9% to 2010), and accumulation - 15.17 billion tons.

The volume of recycling of industrial wastes makes up about 30% of their generation (143 - 153 million tons). Mineral waste recycling is dominating in this statistics (68.4%). It is mainly about low-technology use of overburden and tailings minerals (for construction of dams, roads, various covering) what in the European practice is generally not considered as recycling.

The main sources of waste generation are enterprises of mining, chemical, metallurgical, machine-building, fuel and energy, construction and agriculture complexes.

In 2009-2013 it is possible to observe the decrease of waste generation of I-III hazardous class (1.2-0.9 mln. tons) what is almost three times less than in 1998-2008 (2.3-2.8 mln. tons). There is also the significant reduction in the disposal of the hazardous waste at the sites of non-organized storage.

A special category of highly toxic waste is obsolete pesticides and banned to use chemical pesticides. There is no technologies in Ukraine that meet European standards of hazardous waste treatment, including obsolete pesticides and as to address this issue the waste is transferred outside the territory of Ukraine for the safe disposal at specialized plants in other countries. According to the MENR of Ukraine remainder of obsolete pesticides decreased from 20.5 thousand tons (beginning of 2010) to 8 thousand tons (beginning of 2014) [8].

It is expected that by 2025 MSW generation in Ukraine will reach 450 kilograms per capita per year, or more than 17 million metric tons of MSW annually. At the same time, at present, around 93–95 percent of all MSW is sent to disposal sites: a situation which, inevitably, has negative environmental and economic consequences.

**Methods of MSW disposal in Ukraine, compared to those in other developed countries**

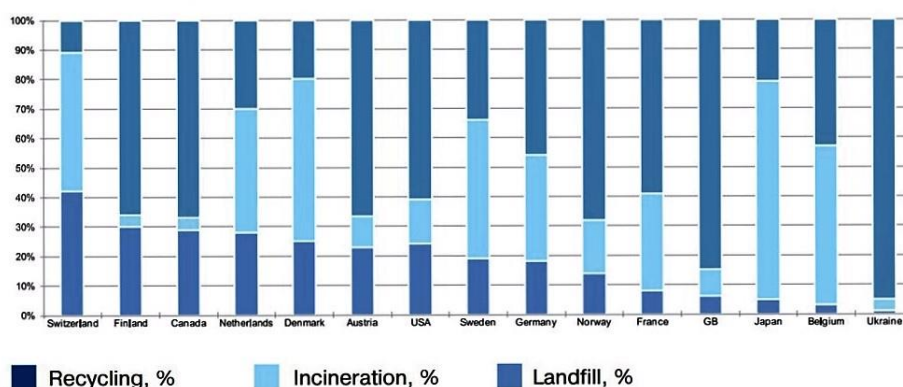


figure 58: Methods of waste disposal in Ukraine

Up to 20 percent of disposal facilities are reported as not meeting current sanitary standards. Toxic substances accumulate in a landfill, infiltrating the soil and groundwater and polluting the air. This can have a number of short-term effects (such as combustion and landfill fires) as well as long-term impacts (decreased biodiversity, soil fertility and harm to human health). The size of most landfill sites (many covering more than 10 hectares) exacerbates these impacts. In total, official estimates indicate that over 20 billion metric tons of MSW are accumulated at landfill sites. The remaining capacity of the largest landfills is expected to expire in three to five years. It is estimated that by 2025 Ukraine is likely to need to double its capacity to accommodate growing volumes of waste. The current rate at which new capacity is created does not ensure the ability to process projected volumes. This challenge is compounded by the fact that around 70 percent of Ukraine's current waste collection and haulage infrastructure is obsolete. Moreover, formal MSW collection services do not extend to a number of small towns and villages. In terms of resource efficiency, current low recovery rates in Ukraine result in the inefficient use of raw materials and energy: and international best practice would suggest significant potential for MSW recovery [9].

Last years the morphological composition of the waste has also changed. If before the major part of waste consisted of food waste, currently 50% of solid household waste consists of package and packaging materials which are mostly not digestible and usually stays in the soils contaminating them for hundreds of years. Rapid increase in use of electronic and electric equipment causes its import to Ukraine and respectively its number increases in the total amount of the solid household waste. Medical and chemical waste has also the significant presence in the general waste composition.

In Ukraine, there is remaining the tendency to increase of the volume of household waste generation and its transportation to the landfills: in 2015 approximately 48 million m<sup>3</sup> of household waste (or 10 million tons) were generated and disposed at 6 thousand dump sites or landfills of the total area 9,000 ha. About 77% of population of Ukraine is covered with the services of the household waste collection and transportation. The single region which has only 62% of coverage is the Cherkassy Oblast.

Through the introduction of the separate collection in 398 settlements, operation of 20 sorting lines, 1 incineration plan and 3 waste incineration facilities, approximately 5.93% of household waste were recycled, of which 2.73% was burned, 3.2% of household waste were transported to the recycling points and waste recycling plants.

In general, in Ukraine as of 01.01.2016 the separate solid household waste collection is introduced in 523 settlements that is 125 more than in 2014. Particularly, it becomes

more widely introduced in Vinnitsa, Dnipropetrovsk, Zhytomyr, Ivano-Frankivsk and Kharkiv Oblasts, mainly through involvement of the inhabitants of the rural area. Positive changes in this area are also evident in Zhakarpattya, Zaporizhzhya, Khmelnytsk and Chernihiv Oblasts.

Meanwhile, comparing to 2014 in Lviv and Ternopil Oblast the number of settlements covered with the separate waste collection services is reduced, mainly, due to the failure of the waste management process organization as well as the lack of capacity of the recycling facilities. 20 waste sorting lines are operating in 15 settlements: in Vinnitsa, Dnepropetrovsk, Zaporozhzhya, Ternopil, Kyiv, Lviv, Odessa Oblasts and the City of Kyiv (6 sorting lines). Recycling of waste is carried out at a waste incineration plant in Kiev and Lyubotin and two mobile incineration installations in Kharkiv City. In addition, the waste sorting complexes are being constructed in 22 settlements.

If the Verkhovna Rada of Ukraine accepts the draft Law of Ukraine On Housing and Municipal Services (registration number 1581-d as of 10.12.2015), which envisages the transfer of authority for the processing and disposal of waste, as well as setting tariffs generally for the waste treatment to the local authorities, the market of processing and disposal of waste will be de-monopolized, and therefore the sustainable development of the household waste sphere is expected.

The situation with the landfill and dumpsites remains the critical. 16% of existing dumpsites are overloaded and 24% do not comply with the environmental standards.

Work on certification and remediation is not properly performed as well. Almost 2300 dumpsites requires the certification while in 2015 less than 450 received the certificate. Namely, 31% of dumpsites require the certification. 9% of dumpsites need to be remediated. 37 of 593 dumpsites were remediated in 2015.

In Ukraine, there is also an urgent need in construction of new landfills which is estimated at more than 524. This problem is especially critical for the most inhabited oblasts of Ukraine, Kyiv and Dnipropetrovsk. However, population protection and public organizations counteract the allocation of land for construction of the new landfills for household waste. The annual MoRD report on household waste management reports that 48 landfills have the leachate collection system, including 28 landfills with the leachate disinfection system and at the others there is arranged either storage tanks or filtrate collected dug in, where the trays periodically transported to the municipal treatment plant. 12 landfills have the biogas extraction system comparing to 9 last years. Separate



collection of electrical and electronic equipment used ecologically dangerous goods do not established.

Due to improper solid household waste management system in settlements, mostly in private housing area, annually almost 28 thousand dumpsites emerged takeing the area of 1 thousand ha. Most of them were eliminated (27 thousand) as it is reported by MoRD.

Ukrainian authorities are also trying to establish market conditions and development of the competitive environment. Thus, in 2015 more than one thousand enterprises were engaged to provide the services of the sanitary cleaning, 25% of which are privately owned. Private operators take 83% of the waste management sector in Kyiv and more than a half in Sumy and Chernivtsi Oblast. More than 15 thousand people are engaged into the sector of the household waste management services provision.

Almost 3.5 thousand specialized waste collection vehicles are used for the provision of the proper services to the inhabitants but the depreciation of the fleets is around 67%. The lowest percentage of depreciation of the waste collection trucks is 42% in Poltava region.

The system of sanitary cleaning of settlements is imperfect: there is no interaction between the State Sanitary and Epidemiological Service, Environmental Service and Housing and Municipal Service for the purpose of monitoring the sanitary conditions of areas as well as the collection, removal, disposal and dumping of household and animal waste.

### 14.2.3 Legal and economic instruments to support waste management hierarchy

#### **Before 1990**

Taking the waste hierarchy pyramid (figure 59) as it is today and considering the state policy of USSR stimulating the recycling and reuse of waste, it is possible to say that the government was seriously interested into efficient use of waste although it is almost impossible to speak about some measures aiming at the waste prevention. Moreover, the state policy of USSR envisaged the awards to those player of the waste management sector which demonstrated the highest level of waste recycling. Significant financial and human resources were also allocated for the development of waste-to-energy plants and construction of landfills throughout the whole country.

## WASTE HIERARCHY PYRAMID

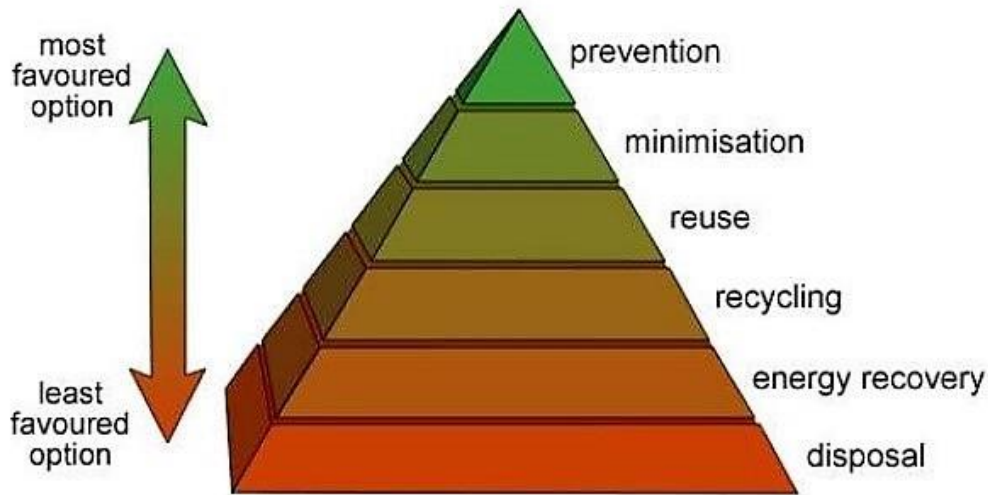


figure 59: Waste hierarchy pyramid

### After 1990

In Ukraine the waste management is carried out in line with the Law of Ukraine On Waste as of 05.03.1998. This document defines legal, institutional and economic principles of activities related to the reduction of waste, their collection, transportation, storage, processing, recycling and removal, deactivation and disposal, as well as prevention of the negative impact of waste on the environment and human health. The Law On Waste also regulates relations connected with the generation, collection, transportation, storage, processing (recycling), removal and disposal of waste generated in Ukraine and transported across its territory, taken out of it, as well as the transportation, processing and disposal of waste imported to Ukraine as a secondary raw material. Starting from January 01, 2018 – the Law on Waste prohibits the disposal of unprocessed waste at the landfill.

Decree of the Approval of Household Waste Management Programme as of 04.03.2004 No 265 determines sets the main objective for the household waste management sector in Ukraine aiming at the creating the conditions to improve the household waste collection, transportation, recycling and disposal as well as limitation of its harmful impact on the environmental and human health.

The following measures are to be taken to achieve the main objective of the Programme:

- Reduce the amount of the waste disposed through introduction of the new and advanced methods of collection, transportation, storage, recovery, recycling and disposal;
- Development and introduction of the new equipment in the household waste management sector;
- Reforming of the sanitary cleaning system;
- Ensuring the control for the existing and closed landfills to prevent their negative impact on environment and human health, sites reclamation after landfill closure;
- Establishing the conditions for the effective use of the household waste as the energy resource and for the research and commercialization of complex processing and recycling of resource valuable components;
- Ensuring the implementation of mechanized sorting of waste with removal of the resource valuable components, processing of materials and products

After signing the Association Agreement the Cabinet of Ministers of Ukraine by a decree of 17.09.2014 No. 847-p approved the Action Plan for the implementation of the Association Agreement between Ukraine, on the one hand, and the European Union, the European Atomic Energy Community and their Member States, on the other hand, for 2014-2017 and approved the major objectives that Ukraine must fulfil.

The basic principle of EU legislation in the waste management sphere is reduction of waste which is transferred to the final disposal through the measures of the waste hierarchy: prevention of generation, re-use, recycling, energy recovery and, finally, disposal.

Ukrainian legislation requires the comprehensive review to approximate it with the EU legislation since the key measures and principles are significantly different in a number of aspects of waste management in general as well as in the treatment of the different types of waste. There is also a problematic situation with the terminology used in the Ukrainian legislation of the sphere which also needs to be adjusted, added and changed, including the issues of the different types of waste, operations of the waste treatment, participants of the waste management market.

Special attention should be paid to the basic approaches set out in Directive 2008/98/EC on the implementation of the waste hierarchy in addressing issues of waste management. Moreover, there is a need to consolidate Ukraine's legislation provisions on the following issues:

1. by-products and criteria for their definition;
2. criteria for determining the end of waste status (when waste ceases to be waste);
3. prevention of waste (including the reduction of harmful substances in the waste) and the introduction of extended producer's responsibility;
4. waste management plans and programs of waste generation prevention.

It is also important to agree on the classification of waste and a list of criteria for determining hazardous waste. Additional regulation is required for certain types of waste (e.g. bio-waste, waste oils). Additionally, the categories of waste treatment which firstly required the introduction of separate collection are not determined in the legislation.

The system of licenses issuing and registration of market participants needs to be also reviewed and approximated to EU legislation. Almost for a year, the entities in the field of hazardous waste management had been working by the nominee licenses. In fact, before the approval of the license conditions for the business involved in hazardous waste management, enterprises could conduct activities without following any rules. Responsibility is provided only for non-compliance with the licensing conditions. Due to the absence of new rules new enterprises that are interested and could invest in Ukraine, could not get to this market [8].

With a view to the proper organization of work on the objectives implementation to bring the legislation of Ukraine in line with that of the European Union, the Ministry of Ecology and Natural Resources of Ukraine drafted and the Cabinet of Ministers of Ukraine approved plans of implementation of the EU legislative acts in waste management, including: amendments to the legislation on waste management in accordance with the EU directives, namely:

- Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste;

- Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC;
- Council Directive 99/31/EC of 26 April 1999 on the landfill of waste amended by Regulation (EC) No.1882/2003.

The main objectives of the implementation plan are to introduce contractual provisions of the Directive, such as:

- adoption of the national legislation and determination of the authorized body (bodies);
- preparing plans on waste management in accordance with the five-stage waste hierarchy and programs on waste prevention;
- harmonization of categorizing waste as hazardous and its classification according to the European List of Waste;
- establishment of a full cost recovery mechanism under the “polluter pays” principle and the principle of extended producer responsibility;
- establishment of a permit system for institutions / enterprises engaged in operations on removal or recycling of waste, with special obligations regarding management of hazardous waste;
- introduction of a register of institutions and enterprises that collect and transport waste.

Ukrainian government has already made a number of steps in the direction of the legislation approximation and improvement of the environmental situation but they are definitely not enough to dramatically change the situation in the waste management. The first step is the National Waste Management Strategy which is under elaboration at the MENR. The Strategy is prepared in collaboration with the MoRD and GIZ to coordinate all the needed steps as well as to introduce the best European practices applicable for Ukraine.

To ensure environmental safety, prevention of the negative impact of packaging waste on human health and the environment, the involvement of secondary raw materials for

the processing industry of Ukraine and due to the need for implementation of the Association Agreement between Ukraine and the European Union, Strategy for Sustainable Development “Ukraine – 2020”, Directive 2008/98/EC on waste in the implementation of the principle of extended producer responsibility, the draft Law of Ukraine On Packaging and Packaging Waste was elaborated.

The aim of the draft Law is to harmonize the legislation of Ukraine in the field of packaging and its waste of EU legislation and to establish a legal framework for the creation of separate collection, integrated processing and recycling of packaging waste, increased use them as secondary raw materials, the introduction of the European experience of the such systems in Ukraine. This law is also a good economic instrument to finance the measures to comply with the waste hierarchy.

The draft Law provides:

- principles of state policy in the field of waste management;
- responsibilities for economic entities that produce and import packaging and packaged goods to reduce the impact of packaging waste on the environment;
- specifies the requirements for packaging and its waste;
- rules for processing and recycling of packaging as a percentage of the total weight of packaging used by manufacturers and importers that first sells the product in the packaging on the market of Ukraine for the first 5 years of operation this Act;
- approval mechanism for the rules of processing and recycling of packaging waste after the expiration of the standards established by this Law directly;
- transparent mechanism for resolving disputes about the order of execution of rules for processing and recycling of packaging waste;
- procedure for registration of producers of packaging and organizations of extended responsibility;
- legal status and principles of activities of organizations of extended responsibilities;
- mechanism of accounting, reporting, monitoring and control within the scope of this Law.

The MoRD together with MENR and Twining Project Introduction of a Management System of Wastes of Electric and Electrical Equipments (WEEE) elaborate the draft regulatory act on regulation of this type of waste. The Project aims to minimize the negative impact of household hazardous waste to preserve the quality of soil, water and atmosphere on the principles stipulated by the EU Directive on waste.

Meanwhile the changes in Ukrainian legislation related to the energy production from the bio-mass is also aiming at the improvement the situation in the household waste management.

The recently adopted Law of Ukraine No. 2010 resolves all major problems faced by power generating facilities that work on alternative energy sources and attract investments (for both commercial enterprises and private households). This includes (i) aligning the term “biomass” with EU Directive 2009/28/EC so that both products and waste are considered as biomass for the purpose of qualifying for the feed-in tariff; (ii) new green tariff rates, introducing home-unit levels, abolishing peak load factors for solar and hydro generation, tiering solar tariffs based on capacity, and setting a degression schedule; and (iii) no mandatory local content requirement. In regards to CMU Decrees No. 293 and 453, the proposed amendments have a number of advantages as compared to the current situation, though these regulatory acts might be further improved in the following aspects:

- Removing from CMU Decree No. 293 the clause about the need to calculate the working cost while taking into account a threshold rate of return not higher than 21%.
- Establishing in CMU Decree No. 293 a tariff for heat energy generated for households with use of alternative fuels at the level of 100% of the weighted average tariff for heat energy generated with use of natural gas [10].

#### 14.2.4 Waste management system financing

##### **Before 1990**

Waste management system was the part of the national economic system of USSR. In the absence of market economy, private players and investments, it's obvious that the

only one source of the system financing was the centralized budget financing from Moscow as the core of the state to other republics depending on their needs.

### **After 1990**

Problems that occur in the waste management sphere requires immediate solution and funding both at the state and local level. Following the Law of Ukraine on Local Self-Government executive bodies of settlement, village and city council are responsible for solving the issues of collection, transportation, recycling and disposal of solid household waste. The issue of investment in this sphere should be addressed comprehensively using all possible sources of funding (state and local budgets, funds of enterprises (with their consent), that provide sanitary clearing services for the settlements). It is necessary to develop and affirm the local programmes of solid waste management and sanitation schemes of settlements.

The Law of Ukraine on Environmental Protection specifies that in Ukraine financing of environmental actions should be carried out through the State Budget of Ukraine, Republican Budget of the Autonomous Republic of Crimea and local budgets; funds of enterprises, institutions and organizations; Funds for Environmental Protection; voluntary contributions and other funds.

Following the Decree of the Approval of Household Waste Management Programme as of 04.03.2014 No 265, which so far is the only one national programme, the financial provisions of the Programme should be performed from the state budget, including the State Fund of Environmental Protection and through attraction of investments.

The Fund is established in 1998 to finance the environmental protection measures and measures related to the rational use and conservation of natural resources. The Fund is formed at the expense of payments of the environmental tax and other payments determined by the legislation.

Taxpayers are business, entities that do not conduct economic (business) activities, budgetary institutions, public and other enterprises, institutions and organizations, permanent establishments of non-residents, including those that perform agent (representative) functions concerning such non-residents or their founders, while conducting activities in the territory of Ukraine and within the limits of its continental shelf and exclusive (maritime) economic zone perform the following activities:



- emissions of pollutants into the atmosphere from stationary sources of pollution;
- discharges of pollutants directly into water bodies;
- waste disposal (except for placing certain types (classes) of waste as secondary raw materials to be placed in its own territory (facilities) of business entities);
- generation of radioactive waste (including already accumulated);
- temporary storage of radioactive waste by producers in excess of the special conditions of the license term.

Tax rates for placing certain types of extremely hazardous waste:

- equipment and instruments, which contain mercury elements of ionizing radiation - 694.91 UAH per unit;
- fluorescent lamps - 12.09 UAH per unit.

Tax rates for waste disposal, which are set depending on the class of danger and hazardous waste (Table 52):

Table 52: Rates for waste disposal at the landfills

Class of danger	Level of hazard of waste	Tax rate, UAH per 1 ton
I	Extremely hazard	1128.63
II	Highly hazard	41.11
III	Moderately hazard	10.31
IV	Low hazard	4.02
	Low hazard nontoxic waste of mining industries	0.39

For the disposal of waste which does not have hazard class the tax rate set for the Class I is applied. For disposal of waste in landfills that do not ensure complete elimination of air pollution or water bodies, the tax rate is increased in 3 times. Coefficient to tax rates, which is set depending on the location (zone) of waste disposal in the environment:

Table 53: Coefficient to tax rate for the waste disposal

Site (zone) of waste disposal	Coefficient
Within the territory of the settlement or less than 3 km from it	3
3 km and more from the settlement	1

Average tariff for household waste management in the country is about 57.65 UAH/m<sup>3</sup>, including disposal tariff 17.15 UAH/m<sup>3</sup>. Average tariff of household waste management for the population is over 48 UAH/m<sup>3</sup>, including for disposal - about 15 UAH/m<sup>3</sup>. Experts estimate that the volume of services implementations of household waste removal in 2015 is more than 1.8 bln. UAH. The volume of paid services is more than 1.65 billion. UAH. (92% of services provided). Total population benefits for the waste collection services provision at the companies' estimates were 49 mln. UAH, 43 mln. UAH were recovered (87%). Over 220 mln. UAH was allocated for subsidized financing for development and maintenance of sanitation in 2015. The largest funding areas of household waste management was observed in Zhytomyr Oblast (about 18 mln. UAH) and Chernihiv Oblast (16 mln. UAH). Accounts payable in the sphere of household waste management in 2015 is 413 mln. UAH, of which over 9 mln. UAH to pay wages. The largest arrears of wages in the city of Kiev. Accounts receivable in 2015 is about 557 mln. UAH, of which the debt of the population of almost 385 mln. UAH, budget organizations - 39 mln. UAH.

Ukrainian government is also attempting to attract the private and business investments into the solid household waste management sector but at the current stage to make these attempts successful the Government needs to introduce the list of changes to make the investment climate more favourable.

Ukrainian authorities also implement the cooperation with international projects in the field of household waste that help implement strategies developed by experts of sphere of household waste in areas at European and international levels. In particular, the German International Cooperation (GIZ), the Swiss-Ukrainian Decentralization Support Project (DESPRO), Partnership for local Economic Development and Democratic Governance (PLEDDG), which is being implemented from April 2015 to December 2020 by the

Federation of Canadian Municipalities (FCM) with the financial support of the Government of Canada, as well as a loan from the fund of the World bank for the construction of international modern landfill for disposal of solid waste in the city of Kharkiv, etc.

The main factors contributing to the current poor state sphere of household waste management sphere is un-regulation in law provisions for setting tariffs and payments for services provision of the processing and disposal of waste and nonfulfillment of requirements defined by the Law of Ukraine On Housing and Municipal services and On Waste by the local authority in terms of lack of financing for development and maintenance of the sector, setting of economically justified tariffs, standards of provision of household waste collection services and proper control of shipments of waste and use of landfills and dumps. At the same time, local governments are in no hurry, and sometimes delayed, with the introduction of modern methods and technologies of household waste.

#### *14.2.5 Public awareness, education and communication initiatives*

##### **Before 1990**

The state policy in USSR envisaged the wide involvement of population into the process of the waste collection and sorting. For this purpose, each school, university or the institution had the relevant plan of activities aiming at efficient collection of paper, glass, metal and other recyclables. Presenting these activities in different forms of cooperation or contests the government successfully implemented the plans and achieved the state indicators.

##### **After 1990**

Involvement and full commitment of the population in the issue of the proper household waste management is crucial for successful implementation of any launched initiative. The efficient communication of market opportunities and initiatives to end users is critical to the success of programs and projects in the solid household waste management sector. Today, Ukraine faces the dual challenge of building demand for quality waste management services while demonstrating that this can indeed be achieved through the implementation of specific policies and projects.

Regardless the gradual implementation of the separate waste collection, public awareness in this issue as well as the general proper waste treatment remains significantly

low. Most environmental projects, including those related to the waste management do not always have the component of population's teaching. There are no measures envisaged in the National Waste Management Programme or any other national regulatory document to teach population of the environmental-friendly treatment of the household waste. The lack of knowledge and understanding, old memories about approaches to waste management in USSR and lack of financing results in failure of the promising initiatives. Most activities related to the increase of public awareness are conducted by some NGOs or projects without the proper support from the national level and governmental authorities.

It is evident that any process that changes people's attitude towards important issues, their lifestyle and everyday habits requires firstly their own readiness and commitment to do it. Concerning the environmental issues in general and waste management particular, Ukrainian population have quite weak knowledge. Usually, even in places when some initiative measures are introduced, like the separate waste collection, they either have some basic understanding or just do not understand at all why they should do it "while someone else is making money of it". To solve the problems of implementation of the waste management strategies, it is simultaneously necessary to involve people in its implementation. In parallel to the development of the conceptual, financial and institutional framework of the strategy, the effective public awareness campaign should be elaborated to inform people about the new system, its main objectives to introduce it as well as the potential results from its implementation.

The situation in the household waste management sector to some extent concerns the population as they can see the number of illegal dumpsites arising next to their homes and settlements. Such indifference can be the good basis for the education and training of the population in case if this is performed periodically so that people feel aware and involved in the whole process with ability to influence its course. If people are not regularly informed about the waste management strategy, its results of implementation and are not properly informed about the measures which require their participation, all efforts to implement even the most prominent strategy can have a negative effect. Thus, a timely implementation of the campaign, especially during pilot projects, is of special importance. In this context, one has to remember that without providing the required infrastructure the campaign can also have a negative impact on public perception, i.e. the introduction of new measures should be always accompanied by the proper explanation of its need to the population and vice versa any announced measure should be

also introduced timely so that people could see the benefit from using it and applying their theoretical knowledge.

In Ukraine reforming of any sphere shows that young people are usually better-informed, enthusiastic and committed to the changes and for this reason, they and should be used as a vehicle to deliver the campaign's messages to the general public.

#### 14.2.6 Barriers and success factors for waste management performance

##### **Before 1990**

Since the moment when the first regulatory act was approved by the state government, the USSR achieved the significant efficiency in the system of waste management. Much attention was paid to the recyclables collection and waste treatment as well as the design and construction of the sanitary landfill. The use of the recyclables considered to be the successful factor of the resource saving. The specialized institute of the recyclables was established by the Gosstab of USSR to provide the scientific and engineering support in the issues related to the resources saving and use of recyclables.

During the transition period from USSR to the independent state of Ukraine with the market economy, the country lost the old instruments in waste management that widely stimulated efficient waste collection, separate collection of recycles. The specialized companies dealing with waste management changed their main field of operation, the waste management sphere lost its significant financing and the government of Ukraine was still in the process of elaboration, adoption and implementation of the new laws regulating the sustainable waste management in the country.

##### **After 1990**

The mechanism of state policy implementation in the sphere of waste should cover the following issues for the successful implementation of the integrated waste management strategy:

- improved regulatory framework to modify the laws and government regulations, development of national standards and regulations, technical and guidelines;
- full coverage of the population with the high-quality waste collection services;

- implementation of the separate waste collection;
- introduction of modern methods and technologies;
- attraction of investment and loans;
- improvement of the tariff policy and promoting recycling
- “green tariff” for electricity produced from waste;
- promotion of the in inter-municipal cooperation and public-private partnership;
- raising population awareness in solid household waste management.

Given the current state of infrastructure and waste disposal facilities, which require significant modernization or closure and permanent increase in the accumulation of waste, dumps and landfills number for its disposal, full approximation to EU requirements and standards in the field of waste management may be provided only in the long-term perspective.

The main problems in the solid household waste management area are related to the following factors:

- technical, which are caused by the weight of the collection of household waste, its separation, processing and recycling, the annual increase in the volume of household waste and changing their morphological structure and the existing tradition of burying waste in dumpsites and landfills;
- economic, related to lack of interest of investors in the application of modern efficient technologies in this area, nonetheless doing the tariff policy, cross-subsidization, depreciation of capital assets sanitation etc.
- organizational, caused by a low level of provision of household waste removal, especially in rural areas and private building, the slow introduction of separate collection of household waste, low level of public participation in the waste management and passive ratio of population to the problems of household waste;
- regulatory requires the introduction of the totally different approaches and hierarchy of waste treatment, elaboration of the new legislation for the sector and its coordination with the European requirements and standards, transferring to the elaboration of the national waste management strategy on contrary to the local programmes which are usually not centrally coordinated, introduction of the extended producer’s responsibility, strategic planning of the waste management sector at the local and national level. [8]

Addressing the following problems are essential in meeting the challenge related to the public awareness:

- raising wider public awareness of the impacts of MSW, for both the environment and human health;
- effectively communicating the features (as well as the advantages and disadvantages) of specific waste treatment methods, and the consequences of their introduction in specific regions or municipalities;
- effectively communicating policy innovations, programs, and initiatives to ensure engagement and compliance; and
- continuous training of end-users to ensure responsible behaviour.

Raising public awareness helps promote responsible behaviour that preserves both the environment and human health, as well as building market demand for MSW management services. For this reason, it is important that awareness raising be allowed for in project budgets: experience in European Union Member States suggests that the costs of effective awareness raising in this sector can be as much as five percent of total capital expenditure [11].

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## 15. Waste management situation in Moldova

### 15.1 Overall background

#### **Before 1990**

Moldova is a small landlocked southeast European country of 33,843 square kilometres located between Romania in the west and the Ukraine in the east. It was a part of the former Union of Soviet Socialist Republics (USSR) but declared independence in 1991 and became a member of the Commonwealth of Independent States (CIS). In the year 2000, Moldova had a population of over 4 million people, with 23 percent of its population 14 years or younger. The population growth rate was zero, implying a completely stable population. The life expectancy at birth was 64 years. It was among the fifteenth most densely populated nations in Europe with 128 people residing per square kilometre. Administratively, the country is organized into 10 judete (divisions), 1 municipality, the capital Chisinau, and 1 territorial unit, Gagauzia (figure 60).



figure 60: Geographical map of Moldova

Moldova's economy is predominantly agricultural-based with a highly fertile land of which 53 percent is arable. Fifty-three percent of the country's population lives in rural areas. Of the urban population, 60 percent is concentrated in the capital city of Chisinau. However, the country has no mineral deposits and imports most of its fuel from abroad.

As a result, Moldova is classified as a low-income group country with approximately three-fourths of the population living below the poverty line.

Moldova, for a large part of its recorded history, has been dominated by other cultures. After World War II, the Russification of Moldova began full scale when private property was abolished, collective farms were established, and a large number of people were deported to Siberia. As a result, the native population became bilingual, speaking both Russian and Romanian. In the 1970s the region was the "bread-basket" of the USSR with its agricultural boom. It was the smallest republic of the old USSR with less than 0.2 percent of the land, but ranked sixth in its agricultural production. However, the undercurrents against the Russification were present throughout the period and gained momentum in 1980s with the introduction of openness and the rebuilding of socio-economic policies by Mikhail Gorbachev.

On August 27, 1991, Moldova became independent with Mircea Snegur as president. It adopted its first constitution in 1994. In 1995 Moldova was admitted to the Council of Europe and ratified its Convention on the Protection of Ethnic Minorities the next year. In 1996, in the first multi-candidate presidential elections, Petru Lucinschi, a member of the Communist Party of Moldova, became the President. Present day Moldova is an ethnically diverse country with about 64 percent ethnic Romanians, 13 percent ethnic Russians, 14 percent ethnic Ukrainians, 3 percent Gagauz (or Turks who migrated in eighteenth century and adopted Christianity), 2 percent Jews, 2 percent Bulgarian, and 2 percent Belarussians and Gypsies. Furthermore, at the advent of twenty-first century, Moldova was reeling under foreign debt and the economy was in disarray with the quality of living at its lowest ebb. In 1999, the debt was 1,572 million lei, and the costs for servicing that loan were as high as 11 percent of the Gross Domestic Product (GDP.)

### **After 1990**

Waste management in the Republic of Moldova has developed only moderately since 2005. International donors increased their involvement in waste management during the last few years and this resulted in improvements in management of obsolete pesticides and expired chemicals, but management of municipal and manufacturing waste is developing slowly and old practices remain.

Restructuring of the manufacturing, industrial, quarrying and agricultural sectors resulted in reduced pressures from waste management on the environment. This development reduced generated amounts of waste and in some sectors also decreased the amount of waste previously accumulated.

The existing waste management infrastructure does not comply with international standards and has to be significantly improved to ensure safe and reliable recovery and disposal of waste. The development of modern waste management infrastructure is still in the initial phase. The Government has prepared a draft law on waste management and a National Waste Management Strategy which was approved by the parliament in 2013. [1]

Waste is the challenging area for the Republic of Moldova. Almost all rural areas are not covered with a waste management system. A regular monitoring system for these areas does not exist. Taking into account that 58% of population is living in the rural areas, this problem becomes more intense. During 2014, 3007 of illegal waste dumps were identified.

In the Republic of Moldova are monitored only the waste generated in urban areas, where a regular collection is organized. Still, collected data cannot be comparable, because we use m<sup>3</sup> as unit of measure, while EEA and UNECE is using tonnes as units of measure.

There is a poor developed separate waste collecting system, as well as reuse and recycling of municipal solid waste. Materials recovery from municipal solid waste is aimed at plastics, paper and metals. Although there is no national approach to materials recovery, a number of private companies are introducing systems for collection of recyclables. Moreover, several municipalities are introducing separate collection of recyclables in the form of pilot projects. Nevertheless, this domain needs investments in order to improve it. [2]

The Moldova Government policy on waste management is consists in the develop of infrastructure and services necessary to adequately protect the environment at global, national and local levels from effects associated with the management of waste generated by citizens, enterprises and institutions.

The improper waste management over the recent years has been affecting the local communities, threatening the environment and contributing to global emissions of greenhouse gases. In the context of economic growth of the volume and diversity of

waste generated, waste management and recycling is a local, national and international priority.

The main problems of waste management in the Republic of Moldova are:

- spontaneous and illegal dumps;
- overload the landfill in some localities and their modest use in others;
- most ramps do not meet sanitary-hygienic and ecological security;
- deplorable condition and even lack of paved or asphalted access roads to the landfill;
- inadequate treatment of organic sludge from wastewater treatment plants;
- animal wastes from household;
- low efficiency of public services of waste management. In recent years, there was a significant reduction in unauthorized landfills and promoting the concept of integrated waste management.

A national network of waste management is being developed, which will include inter-municipal and interregional landfill storage, sorting and transfer stations and waste incineration plants. [3]

The sustainable development in waste management refers to ensuring that the waste they generate are managed in a controlled manner to limit short-term environmental impacts caused by their disposal, and in medium and long term to be socially acceptable and economically feasible.

The waste management hierarchy is a simplified conceptual framework that acts as a guide to the most desirable waste management options, based on the prioritization of waste management options to maximize their durability as follows:

- Prevention: prevention of waste production in the superior part of the hierarchy is the most wanted option. Prevention means a slow-down and inversion of the increasing rate of waste and the hazardous qualities of the produced waste;
- Reuse and recycling. These techniques refer to the usage of waste as secondary type raw materials, either without additional processing (reuse) or with subsequent processing (recycling),

- **Recovery:** This technique refers to the extraction of the value onwards (including the energy) from the produced waste. The recovery includes the utilization of the fuel fraction of waste as an alternative fuel in the production of electrical and thermal energy.
- **Disposal:** This technique is based on the burning in waste storage facilities of waste components which cannot already be sent for reuse, recycling and recovery and are thought to reduce considerably the emissions in the environment.

### 15.1.1 Country profile

Moldova is a former Soviet republic in Eastern Europe. The largest part of the nation lies between two rivers, the Dniester and the Prut. The western border of Moldova is formed by the Prut river, which joins the Danube before flowing into the Black Sea. Moldova has access to the Danube for only about 480 m (1,575 ft), and Giurgiulești is the only Moldovan port on the Danube. In the east, the Dniester is the main river, flowing through the country from north to south, receiving the waters of Răut, Bâc, Ichel, Botna. Ialpuș flows into one of the Danube limans, while Cogâlnic into the Black Sea chain of limans.

The country is landlocked, even though it is very close to the Black Sea. While most of the country is hilly, elevations never exceed 430 m (1,411 ft) – the highest point being the Bălănești Hill. Moldova's hills are part of the Moldavian Plateau, which geologically originate from the Carpathian Mountains. Its subdivisions in Moldova include the Dniester Hills (Northern Moldavian Hills and Dniester Ridge), the Moldavian Plain (Middle Prut Valley and Bălți Steppe), and the Central Moldavian Plateau (Ciuluc-Soloneț Hills, Cornești Hills—Codri Massive, "Codri" meaning "forests"—Lower Dniester Hills, Lower Prut Valley, and Tigheci Hills). In the south, the country has a small flatland, the Bugeac Plain. The territory of Moldova east of the river Dniester is split between parts of the Podolian Plateau, and parts of the Eurasian Steppe.

The country's main cities are the capital Chișinău, in the centre of the country, Tiraspol (in the eastern region of Transnistria), Bălți (in the north) and Bender (in the south-east). Comrat is the administrative centre of Gagauzia.

Moldova is divided into thirty-two districts (raioane, singular raion), three municipalities and two autonomous regions (Gagauzia and Transnistria). The final status of Transnistria

is disputed, as the central government does not control that territory. The cities of Comrat and Tiraspol, the administrative seats of the two autonomous territories also have municipality status.

Moldova has 66 cities (towns), including five with municipality status, and 916 communes. Another 699 villages are too small to have a separate administration, and are administratively part of either cities (40 of them) or communes (659). This makes for a total of 1,681 localities in Moldova, all but two of which are inhabited.

The country has a climate which is moderately continental; its proximity to the Black Sea leads to the climate being mild and sunny.

The summers are warm and long, with temperatures averaging about 20°C, and the winters are relatively mild and dry, with January temperatures averaging -4 °C. Annual rainfall, which ranges from around 600 mm in the north to 400 mm in the south, can vary greatly; long dry spells are not unusual. The heaviest rainfall occurs in early summer and again in October; heavy showers and thunderstorms are common. Because of the irregular terrain, heavy summer rains often cause erosion and river silting.

The Republic of Moldova remains Europe's poorest nation with per capita incomes on par with Nicaragua and Ghana and half that of Albania. After the breakup from the USSR in 1991, energy shortages, political uncertainty, trade obstacles and weak administrative capacity contributed to the decline of economy. As a part of an ambitious economic liberalization effort, Moldova introduced a convertible currency, liberalized all prices, stopped issuing preferential credits to state enterprises, backed steady land privatization, removed export controls, and liberalized interest rates. The government entered into agreements with the World Bank and the International Monetary Fund to promote growth.

Moldova is a parliamentary republic with a president as head of state and a prime minister as head of government. It is a member state of the United Nations, the Council of Europe, the World Trade Organization (WTO), the Organization for Security and Cooperation in Europe (OSCE), the GUAM Organization for Democracy and Economic Development, the Commonwealth of Independent States (CIS) and the Organization of the Black Sea Economic Cooperation (BSEC) and aspires to join the European Union.

Moldova is one of the poorest European countries and the solving of environmental issues does not have the priorities while allocating the budget funds. The main environmental problems that the country has are:

- Pollution of the county's territory with household and industrial waste.
- Poor quality and condition of the water, ground water and soil.
- Low percentage of forests covering the country's territory. Comparing to the European practice of 30% of the forest area, Moldova has only 10% of its territory covered with forest and this percentage is declining due to the intensive deforestation.
- Moldova also has the lowest percentage of flora and fauna, and the extinction and disappearance is mainly caused by human activities.

Agriculture in Moldova is a dominant but not very profitable activity. It is contributing soil erosion, which is a major problem in the country, while fertility of the soil is in constant decline. Economic crisis, like in other countries in transition, had a positive effect, in a form of decrease of pesticide and artificial fertilizers using. The state is making efforts to increase forest covered areas, which would improve land and soil quality and protection.

Industrial production increased since 1998 for about 30%. There are still insufficient data on effects of industry on environment

Tradition as it was for ex-soviet republics, industry waste waters have been discharged without any treatment whatsoever. In Moldova, main industry is food, beverage and tobacco production, which are also major energy consumers, followed by paper and cardboard, furniture and leather industry, as well as heavy machinery.

The environment of Moldova suffered extreme degradation during the Soviet period, when industrial and agricultural development proceeded without regard for environmental protection. Excessive use of pesticides resulted in heavily polluted topsoil, and industries lacked emission controls. The Moldovan government is now burdened with the Soviet legacy of ecological mismanagement. Environmental initiatives are administered by the State Department for Environmental Protection. High levels of pesticide and fertilizer use have been linked with elevated rates of disease and infant mortality. Soil contamination and groundwater pollution are associated problems.[4]

### 15.1.2 Development of economic and environmental situation

The economy flipped into recession in the second half of 2015 due to a drought, weak external flows, repercussions of a large scale bank fraud, and tight monetary policy.

Amid political instability since 2014 and bank fraud, the economy grew 3.6 percent in the first half of 2015.

However, severe drought and weaker domestic activity, reflecting tighter monetary policy and fiscal squeeze, offset the positive contribution from net exports. As a result, real GDP declined 0.5 percent in 2015. After the government guaranteed deposits in 3 insolvent banks with a total cost of 12 percent of GDP, monetary policy responded aggressively to higher inflation.

The National Bank raised the base interest rate to a record high of 19.5 percent, virtually stopping credit growth. Twelve-month inflation almost doubled to 9.7 percent on average in 2015, nonetheless. Remittances dropped sharply in 2015, leading to an expansion of the current account deficit to 8.5 percent of GDP from 7.1 percent in 2014. Foreign reserves stabilized after a drop in the first quarter of 2015, settling to the equivalent of 3 months of imports.

Confronted with lower revenues and financing in 2015, the government adjusted expenditures while prioritizing social payments. Reflecting a weaker economy, high interest rates and lower external grants, revenues dropped 6.2 percent in real terms. Expenditure increased 4.5 percent, but were 6.9 percent below planned levels. Since June 2015, the Government has had to freeze procurement of goods and services, and to ration capital expenditures.

As a result, the government maintained the real value of social spending, while capital expenditures faced a double-digit decline. The cash deficit increased to 2.2 percent of GDP, from 1.7 percent a year ago. The already poor performing labor market remained weak in 2015.

Unemployment increased in three out of four quarters, ending at 4.2 percent by the end of 2015. Employment did not catch up with the increase in the labor force, around 3 percent, likely due to the return of people working abroad. Average earnings in 2015 increased slightly in real values (0.7 percent), probably stemming from an increase in self-employment earnings in the non-agricultural sector, counterbalancing the decline in households' income from employment and agriculture.

However, developments throughout the year 2015 are estimated to have halted this downward trend, with poverty estimated to stand at 41.9 percent in 2015. In addition to the impact of a severe summer drought on the agricultural sector, in which many poor are concentrated, the decline in remittances may have pushed some into poverty and increased the depth of poverty for the already poor.



Although only 27 percent of the non-poor received remittances, those who do are highly dependent on them, with remittances accounting for 55 percent of their income. Furthermore, 15 percent of the poor derive more than half of their income from remittances.

The economy is projected to remain subdued in 2016, with growth close to nil. Net exports are expected to be the main growth driver given the exchange rate adjustment and tighter domestic demand policies. Prolonged low remittances and higher costs of domestic financing coupled with lack of investor confidence after the fraud in the banking system will constrain domestic absorption. The budget deficit is expected to increase to 3.2 percent of GDP in 2016.

Accordingly, poverty is expected to decline only modestly in 2016, by less than one percentage point. Remittances are likely to remain at lower levels, inflationary pressures remain and a recovery in labor markets is not expected in the short term. Although fiscal policies have protected social payments, the overall limited fiscal capacity could affect households through other fronts.

Poverty is expected to stand at 41 percent in 2016. As the economy stabilizes and investor confidence improves, Moldova is expected slowly to regain its growth momentum reaching its full potential by 2017-2018; slight reductions in poverty may follow. As inflationary pressures dissipate, consumer prices are projected to decrease to the central bank's inflation target range of  $5\pm 1.5$  percent starting in 2017.

Along with the economic recovery, fiscal deficits are likely to decline to 2.5 percent of GDP by 2018. Weaker domestic activity will keep the current account deficit on a gradually declining path. The acceleration in growth is expected to be accompanied by a reduction in poverty to 37.5 percent in 2017 and could reach 33.4 percent in 2018.

Moldova has limited macroeconomic buffers and needs to deal with major governance issues. A flexible exchange rate will help mitigate some of the shocks, but efficient public spending and institutions are the most important elements of macroeconomic stabilization.

Major efforts in regaining the efficiency and credibility of the banking sector, fighting corruption and dealing with governance issues are needed to regain investor and consumer confidence. Moldova faces a need for fiscal consolidation to maintain fiscal sustainability, while protecting the less well-off.

A weaker economy, high interest rates, the fiscal cost of the failed banks and lower external financing exacerbate the immediate fiscal pressures stemming from indexation of

social payments. With higher projected public debt and lower external grants and financing, Moldova should concentrate on efficiency gains in public recurrent expenditure and improve governance.

This process needs to take account of the distributional impacts that fiscal measures – either on the revenue or the expenditure side - may have, particularly on the less well-off. Moving forward, strengthening labor markets is critical for growth and poverty reduction. Promoting a sound business environment and improving governance are necessary steps to boost job creation and open up opportunities in the labor market.

The Ministry of Environment and Territorial Development (MoETD) is the main authority responsible for environmental policy and the management of all environmental issues. MoETD funding comes directly from the state budget. Funding covers operating costs and there is no provision made for environmental investments. In the context of economic security, the Republic of Moldova has sufficient soil and climatic resources, which represent a renewable potential of value for sustainable development of a highly profitable agriculture. As for non-renewable natural resources, such as construction materials or raw material for manufacturing thereof, with small exceptions, these are of local importance. The lack of energy resources and minerals calls for an adequate economic policy and is being a restrictive factor for the diversity of economic activities and consumption.

## **15.2 Waste management situation**

The waste management situation in Moldova before 1990 subjected to the same principles, rules and regulations as for the other countries of USSR, described in the Section 15.2. There is the same lack of information on legislation and technologies used which could help to evaluate the results of the waste management by that time. However, even regardless the possible positive results during the Soviet time, the process in 1990s, deep economic recession and lack of financing caused the dramatic damage to the existed system and the necessity to practically restore the system from the beginning.

### 15.2.1 Legal and institutional framework of waste management

Waste management in Moldova remains a difficult and unsolved issue "both in terms of organization and legislation". Although environmental protection is governed by 35 legal acts and more than 50 Government Decisions, legal aspects of waste management are far from being satisfactory, requiring both the legal and institutional restructuring and creation of an integrated system of technical and environmental regulation in the field of selective collection for recycling, recovery, waste disposal and storage. Currently the legal framework regulating the waste management issues includes:

- Law on environment protection, no.1515-XII of 16 June 1993;
- Law on the ecological survey and estimation of impact on the environment, no.851-XIII of 29 May 1996 ;
- Law on natural resources, no.1102-XIII of 6 February 1997;
- Law on the charges for environment pollution, no. 1540-XIII of 25 February 1998;
- Law on production and household waste, no. 1347-XIII of 09 October 1997;
- Law on the regime of hazardous products and substances, no.1236-XIII of 3 July 1997;
- Law no. 40-XV of 19 February 2004 on the ratification of the Stockholm Convention on Persistent Organic Pollutants;
- Government Decision no. 1296 of 20 November 2008 on the procedure of charging environmental payments for import of goods in the process of use, causes environmental pollution and for plastic and / or tetra-pack packages of import goods.

Since 2005, the legislation on waste management has remained the same. The legal framework for waste management in the Republic of Moldova is based on the 1997 Law No. 1347-XIII on Industrial and Domestic Waste. The Law regulates waste generation by applying norms of waste generation which define maximum allowed generation of toxic waste. These norms have to be approved by the Ministry of Environment and Ministry of Health. Ministries, local administrations and waste generators are required to prepare programmes for waste management based on the National Waste Management Strategy. The local administration is also responsible for preparation of registers of disposal sites, including their characteristics, and reports this information to the Ministry of Environment.

Furthermore, this Law defines requirements for minimizing the impact of waste management on the environment by implementation of clean technologies and by disposal of waste only on permitted developed sites. Import of waste (except for recyclables) and waste incineration are forbidden.

This key legislative norm for the regulation of waste management reflects the situation in the country at the time it was adopted by the Parliament and does not support the introduction of modern methods of waste management. It covers the main issues relating to environmental protection policy, minimizing the impacts of waste on the environment, and reporting. However, it lacks regulations which set standards for the operation of facilities. The general ban on incineration of waste is in contradiction with international practice. A new waste law was drafted by the Ministry of Environment and was going through the approval process by the parliament in the first quarter of 2013.

The 1993 Law No. 1515-XII on Environmental Protection empowers the Ministry of Environment to develop waste management policy; to carry out the State control aimed at verifying the compliance of individuals and legal entities with waste management legislation; to issue and withdraw permits for waste management activities; and to perform expert evaluation of programmes, schemes and projects in the waste management sector.

The 1996 Law No. 851-XIII on Ecological Expertise and Environmental Impact Assessment included waste management facilities in the list of objects which must undergo the process of environmental impact assessment (chapter 2). There is no evidence that any EIA was carried out for a waste facility in the country.

The 2001 Order of the Minister of Environment and Spatial Planning No. 67 approved the Master Plan for Construction of Solid Waste Landfills, developed by IPROCUM, a design institute which designed several disposal sites in the Republic of Moldova. This Master Plan was prepared in accordance with the requirements of normative and legal acts in construction and environmental and human health of the Republic of Moldova. It contains technological and technical solutions for landfill construction for settlements, divided into three categories according to population (3,000 to 5,000; 10,000 to 15,000; 20,000 to 30,000) and also defines the landfill lifespan at 20 years, from which landfill size and capacity, number of machines and mechanisms necessary for operation, and number of staff is derived.

The 2008 GD No. 1296 on environmental payments on import of goods which in the process of use cause environmental pollution and on imported plastic and tetra-pak packaging, introduced the producer's responsibility principle.

The Ministry of Environment is responsible for waste management policy and planning at the national level. Despite increasing focus on modernization of the waste sector, the number of core staff in the Ministry's Department of Pollution Prevention and Waste Management dedicated to the sector remains low – two persons directly responsible for waste management and two for chemicals management and industrial accidents. However, for individual waste management projects, separate offices were established before 2005, subordinated to the Ministry of Environment. These offices cooperate with the core staff of the Ministry.

Responsibility for financing investments in waste management infrastructure is shared among the Ministry of Finance, Ministry of Economy and Ministry of Environment, which provides co-financing from the National Environmental Fund.

The Ministry of Health is responsible for management of waste generated in healthcare facilities and for categorization of toxic waste. The State Sanitary and Epidemiological Service of Public Health has a good understanding and overview of the situation regarding healthcare waste management in the country (figure 61).

Pursuant to the 2006 Law No. 111-XVI on Safe Deployment of Nuclear and Radiological Activities, the National Agency for Regulation of Nuclear and Radiological Activities was established in 2007. The Agency is a single regulatory authority on radiation protection and safety under the Ministry of Environment, as a separate legal entity with independent structure and budget. It is also responsible for operation of the Radioactive Wastes Storage Facility in Chisinau and for permitting and monitoring of this waste.

The Radioactive Wastes Storage Facility is the only operator authorized for long-term storage of radioactive wastes and disused radioactive sources. It also has authorization for the collection and transportation of radioactive wastes and other radioactive materials on specialized transport by road. The Facility was created in 1960 as a "Radon" type, being initially designated for storage of solid, biological and liquid low- and intermediate-level radioactive wastes. Its old "Radon" facility has not been used since 1990 and will be decommissioned, but the date has not yet been set. First, a safety assessment of the "Radon" facility has to be performed. The light terrestrial facility will be used for

storing decommissioned and reconditioned wastes. At the moment, all disused radioactive sources and received wastes are kept in terrestrial storage for high-activity spent sources.

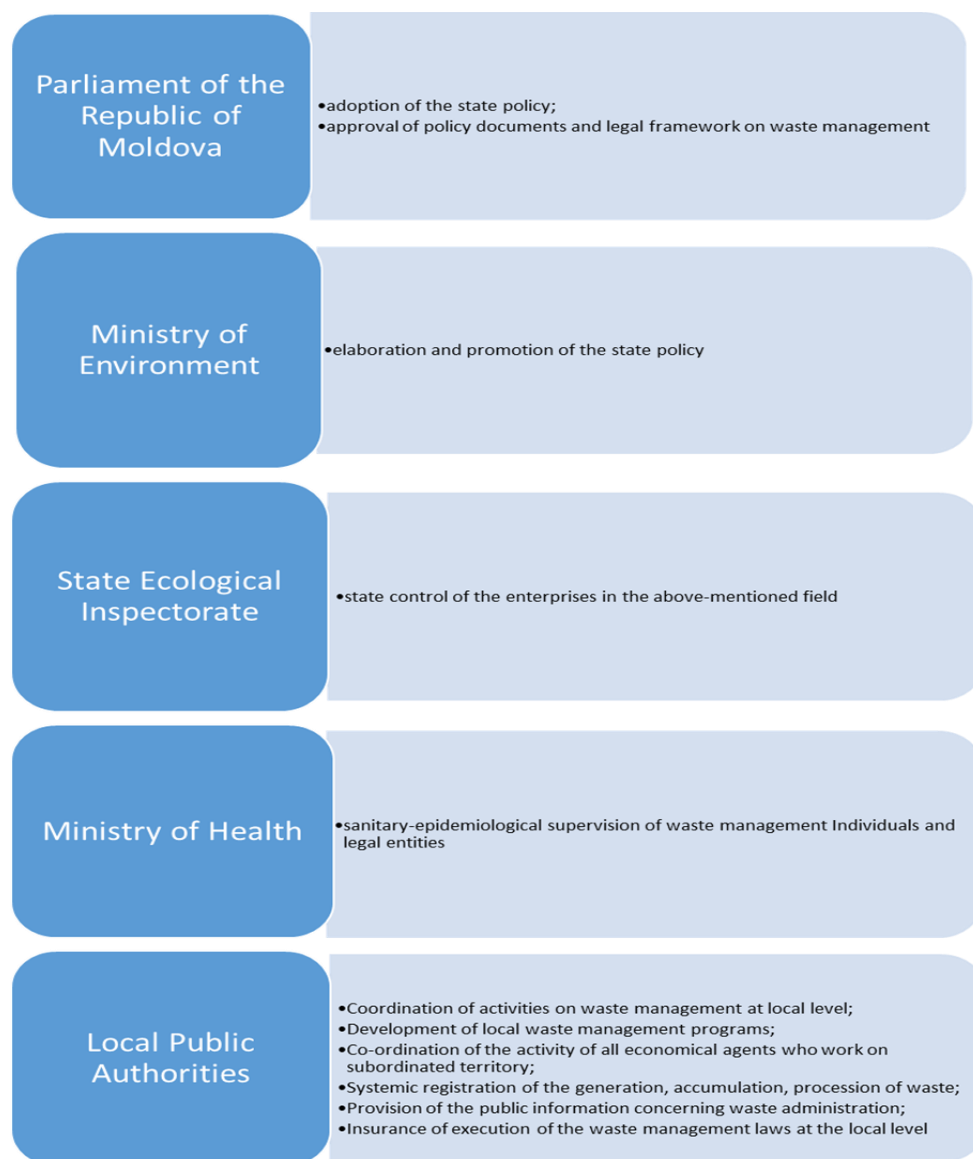


figure 61; Institutional framework of waste management in Moldova

### Overview of WM market actors

As it is possible to see on the figure 61 the waste management sector in the Republic of Moldova has a number of different representatives at the various levels.

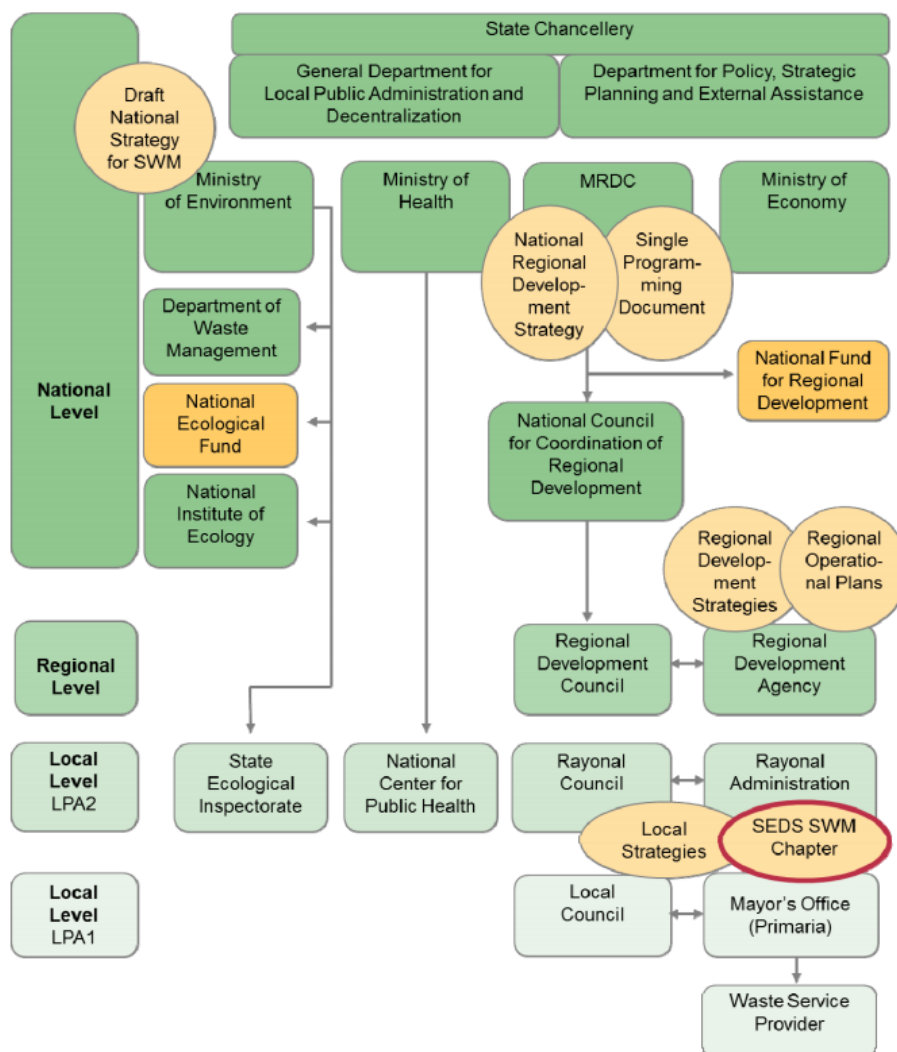


figure 62: Key actors in the waste management sector in Moldova

The key actors are:

The State Chancellery coordinates and ensures the strategic planning processes within the central public administration and establishes the methods and organizational framework for public decision making. It coordinates and monitors the performance of central public authorities, including activities related to their internal reforms in order to achieve the country's strategic European integration objectives. The State Chancellery also manages the process of programming, managing, monitoring and evaluating external assistance to Moldova.

With the change of Government in September 2009, the present Ministry of Regional Development and Construction (MRDC) was created, which has since then coordinated

the creation of Regional Development Councils and Agencies. The ministry is responsible for the implementation of sector strategies at regional level.

The National Fund for Regional Development (NFRD) is a national funding source for regional development priorities, comprised of at least one percent of the state budget plus additional funds from development partners or other sources. GIZ selected the MLPS pilot projects from the pool of NFRD proposals in order to align itself with this institutionalized process of identifying public investment priorities.

The Ministry of Environment (MoE) is responsible for the efficient management of water resources and waste as well as for environmental protection. The MoE provides the strategic policy as well as the legislative and normative framework in the environmental sector. Thus, it includes developing, monitoring and evaluating the national SWM strategy. The National Ecological Fund (NEF) of the MoE provides funding to environment-related projects.

The State Ecological Inspectorate (SEI) is the subordinated unit of the Ministry of Environment and is responsible for the state control of the respective legal framework and environmental policy.

The Ministry of Health (MoH) and its deconcentrated entity, the National Center for Public Health (NCPH) is responsible for the sanitary epidemiological supervision in the country.

Regional Development Agencies North, South and Center (RDA) are responsible for the development, monitoring and implementation of the projects in different sectors, including pilot projects, which are also financed by GIZ. Furthermore, they are responsible for the updating of the regional development strategies and its regional operational plans.

LPA2 (rayon administration and rayon council) is responsible for the development and implementation of the socioeconomic development strategies for the rayons, which includes the SWM sector (Government of the Republic of Moldova, 2006b: art. 43j).

LPA1 (Primaria) is responsible for implementing the services in its community. According to the law they are responsible for "waste collection and management, including sanitation and maintenance of their land for storage" and "the establishment and management of municipal enterprises" that may provide this service (Government of the Republic of Moldova, 2006a, art 4b and 4l). [5]



### 15.2.2 Development of waste management situation and infrastructure

According to the statistical data, the production of waste in the Republic of Moldova ranges annually, while the amount of the used and inhumed waste increases. Even if some waste processing enterprises work in the Republic of Moldova, the information on the volume of recycled waste is not under statistical monitoring.

In 2008, a total amount of 2,841.7 thousand tonnes of waste from the activity of enterprises was produced. Most of them, about 1,570 thousand tones are represented by the waste derived from food processing and beverage industries, 540 thousand tonnes from the extraction enterprises, 249 thousand tones from animal breeding. Only 30% out of the total amount of production waste have been used, 50% have been eliminated by storage, while 20% are kept on the territory of the enterprises.

The monitoring of the toxic waste is performed on the base of the form „F-1 Toxic waste”. Though the number of enterprises that report on the production of toxic waste increased from 352 to 892 during the monitoring period (1995 – 2009), the accumulated amounts of waste decrease, on the ground of the economic decline that has been registered at end of the previous century and due to the structural changes of the industry of the Republic of Moldova.

Up to the moment, the collection and processing of information related to the types and amounts of waste are performed under the standards of the former USSR, without being adjusted to the European classification requirements. Currently in Moldova two separate classifiers for waste and toxic waste are applied, while in EU the Waste List is applied, including hazardous marked with an asterisk.

The waste management is one of the difficult issues of the Republic of Moldova. The worsening of the matter of waste, and especially that related to solid household waste, is caused by the inefficient way the waste processing stages.

The production of municipal waste is influenced by a great number of factors and the most important are:

- income of the population;
- behaviour of consumers;
- appearance of new packed products on the market and the demographic situation.

A research of the International Bank shows that along with the increase of the level of income of the population the rate of waste generation per capita increases as well, which in rural areas usually is 0.3-0.4 kg/capita/day and 0.9 kg/ capita/ day or higher in urban areas. The consumption of food products generates today more waste. The introduction of new packages, especially those of plastic, has a significant impact on the environment. The packages made of polyethylene terephthalate (PET) have lately replaced the glass packages, while the bags, purses or the polyethylene (PE) boxes have replaced those of paper, influencing in this way the structure of the produced waste. The increase in the number of supermarkets and the growth of the GDP per capita have caused the purchase of packed products, and therefore, the produced waste. Demography also influences on the production of waste, and as a rule, the inhabitants of the urban areas produce more waste than those from the rural areas.

Data on management of municipal solid waste are collected by the National Bureau of Statistics. Data are requested from waste collection companies, which report annual waste volumes collected. Data on generated MSW are not available but, considering that only the urban population is served by regular collection, only about 50 per cent of waste generated in the Republic of Moldova was collected in 2011.

The amount of collected MSW doubled during the last decade. The view on collection of MSW from a territorial perspective shows that the majority of MSW is generated and collected in Chisinau – more than two thirds of all MSW collected in the Republic of Moldova. Thus, the increase in collected MSW can be related to the increase in GDP per capita (PPP based) in the capital, but in other parts of the Republic of Moldova the increase in collected MSW was higher than the national average and, therefore, improvement of collection services may be the reason for the reported increase in MSW (Table 54).

Table 54: Development of municipal solid waste collection in Moldova

	2000	2005	2006	2007	2008	2009	2010	2011	2012
Collection	1,144.	1,268.	1,353.	1,790.	2,130.	2,211.	2,302.	2,350.	2,421.
SHW (ths. M3)	6	5	6	6	8	3	6	0	1

The composition of municipal waste in Chisinau was analysed at least two times. The results indicate a high proportion of biodegradable waste what is typical for developing countries.

The effective planning of waste management is based on the morphological composition of the solid household waste. The morphological analysis of waste is imperative for the settlement of recycling and disposal operations for the produced waste. The morphological analysis of waste is paramount in establishing the generated waste recycling and disposal. The morphological analysis of SHW in the country is performed occasionally, and in most cases with the support of NGOs.

These data have been gathered from informative notes, reports, special publications, while the national statistics has nothing to say with regard to this issue.

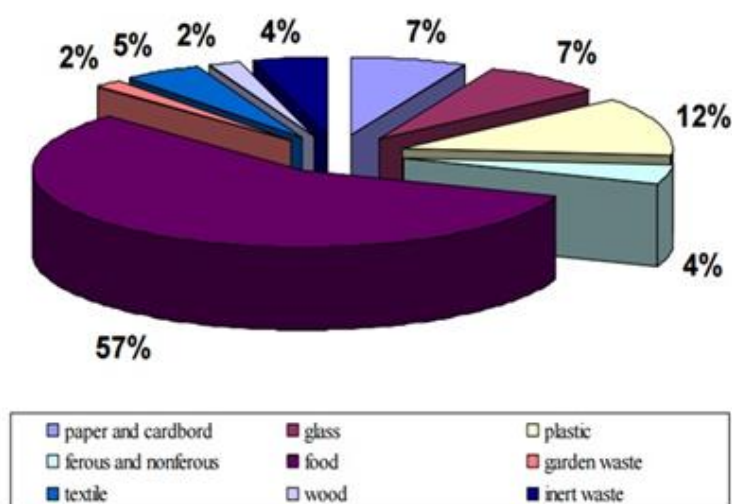


figure 63: Waste composition in Moldava

In Moldova, similar to other post-Soviet countries with insufficient financing, landfills remain the main way to treat the waste. But the lack of financing, comprehensive strategies, responsibilities at the administrative level as well as household do not allow building the sanitary landfills complying with the norms and standard of the developed European countries. Existing landfills do not meet approved environmental and sanitary-hygienic conditions, lack of dam embankments, platforms designed, protective fence, guard service, tracking and monitoring of waste stored. Failure of drainage works necessary to substantially reduce the landfill of municipal waste management efficiency

increases the risk of soil and water pollution. A critical ecological situation is found in overloaded landfill solid waste disposal in Orhei, Comrat, Edinet, Balti, Hincesti and Rezina towns. Also, most localities do not apply to integrate waste management and collection and disposal activities to carry their unplanned and chaotic character.

Annually are found around 3000 illegal dumps, only large and medium-sized, the small ones being practically very numerous. Most of these dumps are located on the banks of ravines and small rivers and near wells and springs. Although in recent years have been eliminated about 70% of the illegal dumps, they reappear in most communities. This critical situation is subject to minor punishment of these activities, the careless attitude of the population and local administration, insufficient human resources, technical and economic studies to prevent and resolve this problem. Endless piles of trash not only affect the environment and public health in this area, but also transform our villages and blooming gardens in fields and huge holes of waste.

In 2009, the maximum number of identified illegal dumps is registered in Chişinău (213), in ATU Găgăuzia (122), in Căuşeni (180), Ştefan-Vodă (101), Cahul (116) Leova (102) Hânceşti (130), Orhei (103) Rezina (109) and Briceni (130) districts. The minimum share of the liquidated dumps is found in districts of Râşcani (13%), Leova (13%), Anenii Noi (23%), Edineţ (35%), Cimişlia (35%) and Hânceşti (36%) [1]. The number of dumps discovered and liquidated depends not only on the size of settlements, technical assistance and financial effectiveness of sanitation, but also on the frequency, area and efficiency of evidence and monitoring measures of these dumps. In the combat with illegal dumps is advisable to extend the construction of platforms for the collection of waste, including animal waste and the recycling and adequate application of the provisions of the new Code in this field.

### **Energy and materials recovery**

There is no material recovery from MSW in Moldova today. There are local actors that recycle industrial waste but no one has focused on material recovery from MSW. Moldova has quite a fast economic growth and the presence of paper, plastic, glass and metals increases while organic waste decreases in percentage. There will be some time before Eastern European countries will reach the recycling level of Western European countries. In a country like Moldova, first of all, there is a need to work with social aspects of development. Later, other issues such as more sophisticated waste manage-

ment, using full cost accounting and extended producer responsibility, might be introduced. Recycling should focus on efficient use of recycled material, energy conservation and environmental protection. In the model, presence of a good infrastructure for waste management and a well-informed population was assumed, something that may not be in Moldova. [6]

### **Extended Producer Responsibility**

The Waste Management Strategy of the Republic of Moldova for 2013-2017 (Government Resolution 248 of 10.04.2013) envisages the development, in 2014-2016, of an EPR system for "all types of waste". However, according to the draft Law on Waste, priority would be given to five waste streams: waste electrical and electronic equipment (WEEE), end-of-life vehicles, used oil, batteries, and packaging waste<sup>4</sup>. The EPR should ensure "a fair distribution of the cost burden between producers and consumers". The draft Law on Waste was submitted to the Parliament in April 2013 but has not advanced there.

Art. 12 of the draft Law on Waste currently stipulates that "every physical person or legal entity engaged in the production, processing, distribution or trade of goods" should be subject to the EPR regime.

The same article establishes norms for manufacturers and distributors of products subject to an EPR regime, including registration, reporting and record-keeping requirements. Article 50 deals specifically with the management of electric and electronic equipment waste.

The system would be introduced through a number of government regulations that are expected to specify recycling targets. A technical regulation was prepared several years ago on EPR for packaging, but it was not adopted because of the lack of framework legislation. A few years ago, the Ministry of Environment commissioned a draft regulation on EPR for waste oils from the Institute of Ecology (with resources from the National Environmental Fund), but this draft has not yet been produced.

The Ministry of Environment is in the process of creating a three-tier information system for waste management which would constitute an important element of the future EPR schemes. It will include a database of waste types (according to the international classification), a register of waste producers and a register of accredited waste recyclers. [7]

The company "I.M. Regia Autosalubritate" provides waste collection and disposal services to Chisinau. The municipally owned company employs 350 people and operates a

fleet of collection vehicles, and a transfer station and landfill at Tintareni. The company is modernizing the collection fleet. In addition, containers of a Russian type (0.75 m<sup>3</sup>) are being replaced by standard Eurocontainers (1.1 m<sup>3</sup>).

Currently, there are 7,800 containers of 0.75 m<sup>3</sup> capacity and 1,500 containers of 1.1 m<sup>3</sup> capacity distributed throughout Chisinau. These containers are collected daily, including weekends and holidays, and the town centre is served twice a day. The waste collection scheme for municipal waste from Chisinau is designed so that waste is taken to a transfer station in Chekani, which lies on the outskirts of Chisinau, and from there it is transported 20 km to the landfill at Tintareni.

Outside Chisinau, collection is organized by municipal authorities. Research done in the Development Region South has found that the collection equipment is sufficient to provide collection services and municipalities are actively searching for investments in the modernization of waste management infrastructure. Waste management services are organized only in urban areas. Due to the fact that approximately 25 per cent of the population live in urban areas (excluding the municipalities of Chisinau and Balti), the number of beneficiaries of the service is quite low. The frequency of household waste collection is daily, and waste collection routes are usually well defined.

The current waste management practice relies on disposal in dumpsites. These are, in the majority of cases, small, uncontrolled and operating without an environmental permit. Only 12 national level permits have been issued for disposal sites in the Republic of Moldova. The remaining 1,864 disposal sites are operating on a land allocation decision issued by the local council. The landfill at Tintareni was developed according to the 2001 Master Plan for Construction of Solid Waste Landfills prepared by the State Institute of Design (IPROCUM). The landfill was put into operation in 1991 and ceased operation in 2010 by the decision of Chisinau Municipal Council. The reason for cancelling the operation was the end of its lifespan, defined by IPROCUM as being 20 years. However, the full capacity of the site was not reached; of the designed 44.2 million m<sup>3</sup> only 19 million m<sup>3</sup> was used. The designed waste generation rate was overestimated and the Tintareni landfill has potential to receive waste from Chisinau for another 20 years. Due to the closure of Tintareni landfill, "I.M. Regia Autosalubritate" does not have any other option than dumping waste in a temporary location in the vicinity of the waste transfer station, without any measures to control potential pollution. Typically, each district has one larger disposal site, which serves the district administrative centre, and a number of smaller/rural dumpsites serving one or more villages. Based on the dumpsite inventory done in the Development Region South and local research, there are approximately 20

to 25 rural dumpsites operating by the decision of local authorities and, in addition, more than 100 illegal dumpsites per district. In most cases, the licensing procedure is formal and the majority of approved dumpsites do not, to a large extent, follow the requirements for construction, environmental protection and human health.

Close to the waste transfer station at Chekani, a private company, ABS, is developing a modern waste sorting plant with a final capacity of 60 t/h of mixed MSW. For comparison, if the plant is operated at full capacity (three shifts) this corresponds to the annual MSW generation of Chisinau. Currently, the first of six lines is being assembled. Once the cooperation of Chisinau waste collecting companies is secured, it is expected that the amount of waste for disposal will decrease by 50 to 60 per cent. However, there does not seem to be a contract or clear cooperation between the city authorities and this private company; thus, the success of the project is at risk. This private company also provides separate collection of waste plastics throughout the whole territory of the Republic of Moldova, having only 1,500 containers in Chisinau.

National authorities are focusing on reducing illegal dumpsites. The total area of the 1,864 identified dumpsites is approximately 1,400 ha. A number of municipal dumpsites, which in total cover about 40 per cent of this area, are operating without a permit. As a result of efforts by the environmental authorities, the area occupied by unauthorized dumpsites has decreased from 686 ha in 2004 to 434 ha in 2009. In the percentage ratio, this decrease is even more evident – from 61 per cent in 2001 to only 31 per cent in 2009. The total number of unauthorized dumpsites also trended downward, from 1,356 in 2001 to 854 in 2009, and their share of all dumpsites from 73 to 46 per cent.

Recently, several districts have improved their waste disposal systems and at-source waste separation in cooperation with international donors. Leova District benefited from cooperation with the Czech Development Agency in 2009 by developing a waste management plan, introducing separate collection, closing existing dumpsites and upgrading another disposal site which has less environmental impact.

Soldanesti City developed a regulation on local waste management and environment protection in cooperation with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in 2010. This cooperation includes the introduction of the 3R approach (reduce, reuse, recycle) to improve waste management and should result in remediation of existing dumpsites, development of a new disposal site and expansion of the waste collection system implemented in Soldanesti to seven neighbouring villages, thus introducing a regional approach to waste management. [8]

Currently, the most widely used method of household waste treatment is storing waste on the ground, which often is a major source of soil and groundwater pollution. In this context, sanitation of settlements and urban waste management is an important objective of the local government structures. Annually through sanitation services in urban areas around 1,144-2,210 thousand m<sup>3</sup> of waste is transported to SHW deposits.

Another negative aspect of the inefficient waste management is that many recycling and useful materials are stored together with the non-recyclable waste, therefore a great part of their useful potential is lost (paper, glass, metals, plastic materials); being mixed and contaminated from chemical and biological point of view their recovery is troublesome. The rate of the daily produced waste by a person ranges from 0.25 kg in Nisporeni town and in Cimislia town, to 0.8 kg in Balti and 1.3 kg in Chisinau city. This difference may be explained through the waste management practices implemented in the respective settlement, where the daily collection and monitoring of waste is performed, the indexes show higher values. The minimum rate of waste production may be explained by the absence of a waste collecting system, thus the waste is transported to unauthorized waste storage places and it is not estimated.

The local governments are responsible for the organization of waste collection and disposal systems and therefore appropriate rates should be set in order to ensure the financing of these activities. The special waste collection and disposal services are rendered in municipalities, in all the district centres, therefore the municipal waste management is well-organized with the support of these services that work under a contract concluded with individual generators, however, this system covers only 60 – 90% of the generators of municipal waste from the urban areas.

In the rural areas, no services of waste management exist in most settlements; therefore, the transportation of waste to the waste storage places is performed personally by the generators except for waste collection services established in some of the rural areas. The number of persons from the rural areas who use these services is relatively low because of the lack of financial sources. A small part of the rural settlements, and namely those situated in the neighbourhood of district centers, are serviced by special waste management entities (Chisinau, Falesti, Ungheni, etc.).

The current waste storage facilities are not operated properly: they are not compacted and covered with inert materials in order to prevent the fires, the spread of unpleasant smells; there is no strict control of waste quality and amount within the waste storage facilities; there is no program of recovery of the produced bio-gas or for the recovery/treatment of the filter; the roads to the waste storage facilities are not maintained;



the vehicles that provide the transportation of waste are not washed after they leave the storage places; the waste storage facilities are not railed in, they do not have an entrance or warning billboards.

Waste generators have the obligation to organize activities of production waste management. The economic entities carry out these activities with their own sources or use the sanitation services.

### 15.2.3 Legal and economic instruments to support waste management hierarchy

The Moldova Government policy on waste management consists in the develop of infrastructure and services necessary to adequately protect the environment at global, national and local levels from effects associated with the management of waste generated by citizens, enterprises and institutions.

The Government plan establish the legal and institutional framework to support the gradual correspondence of the waste management practices to the European Union ones. Through some international, national and local partnerships it expects to encourage and attract the investment required to enable sustainable development of the sector, in line with priority needs and in a pace accessible to the society.

National Waste Management Strategy of the Republic of Moldova for 2013-2017 (NWMS) aims to develop infrastructure and services necessary to properly protect the environment and human health, develop legal and institutional framework required to support the gradual correspondence of domestic waste management practices to the European Union ones through international, national and local partnerships attracting investments needed for sustainable development of the sector according to the priority needs and in a pace accessible to the society.

The development of the NWMS aims at creating the necessary framework for the development and implementation in an integrated and efficient system in social, economic and environmental terms.

The sustainable development in waste management refers to ensuring that the waste they generate are managed in a controlled manner to limit short-term environmental impacts caused by their disposal, and in medium and long term to be socially acceptable and economically feasible.

The National Waste Management Strategy implies a systematic approach aimed to create a waste incorporated management and is planned for the period of 2013 – 2027, and is to be periodically reviewed according to the technical progress and the requirements on the environment protection.

Initially, the activities were be planned for a five year term (2013 – 2017) and were concentrated mainly on the improvement of the legal and normative framework in accordance with the international standards, on the elaboration of plans and regional waste management strategies; introduction of producer responsibility and other obligations for them to waste recycling and management according to the principles of the waste hierarchy; the creation of collection and investment capacities in waste management infrastructure, which meets international standards. [9]

The issue on the waste management in the Republic of Moldova is for a long period a matter of priority in this period of transition to the market economy as a result of the appearance of a large variety of goods of current consumption, as well as their packages. The complexity of issues and standards in the field of waste management leads to increase of requirements regarding waste recycling, treatment and/or disposal installations. A controlled waste management system means recovery and recycling, closing the waste storage facilities that do not comply with the requirements and the decrease of quantity of stored bio-degradable waste. Up to date, the flow of waste was extremely simple, being more a logistic than a technological one.

Average solid waste generation per capita is 350-450 kg/year in urban area and 200-300 kg /year in rural area based on the reports of Ministry of Environmental Protection. The payments for waste collection 3-5 € / year / person in urban area and 4-8 € / year / person in rural area [10]. Meanwhile the full solid waste service in Moldova required 1 to 2% of GDP. Additional sources of financing is the environmental pollution tax for business which is 0.1% of the minimum salary in the country.

Environmentally related product taxes include taxes levied on the sale of a product or group of products with an important environmental dimension to either production or consumption. They include both those taxes which have been explicitly introduced for environmental reasons (which is the case in Moldova) and the much broader group of taxes, such as those on motor fuels and other energy products, which have significant environmental implications, even if the principal purpose of the tax is revenue generation. Regardless of the original motivation of the tax, it can have environmental effects through its influence on the behaviour of producers and consumers.

Environmental taxes on harmful products were introduced in Moldova by 2002 amendments to Law No. 1540 of 25.02.1998 "On payments for environmental pollution" and have been in place since 2003. They are imposed on 20 product categories and apply to physical persons and legal entities importing such products and putting them on the domestic market. The Government of Moldova maintains that almost none of these products are manufactured domestically, so their exclusive application to imports does not create a competitive advantage for domestic producers.

The fundamental problem with Moldova's system of environmental product taxes is that it does not target or affect producer or consumer behaviour but essentially serves to generate revenue for the NEF. The tax on packaging bears a very high administrative cost (partly due to the poor definition of packaging in the law, partly due to the great number of entities subject to this tax) but no real impact – an ad valorem tax on packaging does not stimulate a shift to imported products using less packaging. Where a tax could be effective in changing producer or consumer behaviour – for fertilisers, pesticides, paints and lamps, the tax differentiation between dirtier and cleaner alternatives is either non-existent (for fertilisers) or too small (two percentage points). Taxes on batteries and motor vehicles, where the key environmental problem is their safe end-of-life collection, processing and/or disposal, are not optimal instruments and should be replaced by respective EPR schemes.

National Waste Management Strategy for 2013-2027 developed according to EU Directives and approved in 2013, sets waste management goals in line with EU principles. It sets clear objectives and implementation measures for each waste stream and estimates the costs of these measures at EUR 375 - EUR 470 million for the period.

Based on this Strategy, the Government of Moldova undertakes to develop a new legal and institutional framework on waste management regulation under the EU legislation, which would be economically efficient and would assume human health and environment.

According the National Strategy is foreseen to create an integrated management of waste, based on regional approach, territorial division of the country in 8 waste management regions, regional infrastructure development for SHW deposit and transfer stations, development of collection systems and treatment of specific waste flows (packaging, tires, batteries) by promoting and implementing the principle „producer responsibility“ („the pollutant pays“) including the hazardous (medical waste, waste oils, etc.) waste, (one collection point at the region level).

Law on waste was adopted on 03.03.2016 by Parliament in first reading in accordance with EU Directive 2008/98/EC for promoting the principle of extended producer responsibility and consumer for waste collection and disposal. Meanwhile, secondary legislation has been developed and is to be promoted after the adoption in the second reading of the Law on waste, namely Regulations on (i) waste landfills; (ii) waste electrical and electronic equipment; (iii) packaging and packaging waste.

Even if the situation in the field of waste management continues to be extremely sad, during the period of 2004 – 2006 the LPAs received about 1 million Euro from the EC Good Neighbourhood Program. At the moment, 4 projects with a budget of 15 million MDL, which are supported by the same program, are under implementation. The total investments made in the field of waste management in the period of 2005 – 2008, intended for the purchase of containers, specialized equipment for the transportation of waste, as well as for the liquidation of landfills during the last years amount to several millions of Euro. The National Ecological Fund allocated about 51,728,911 MDL, mainly for the liquidation of landfills and the arrangement of the SHW storage facilities, purchase of containers for waste and auto scavengers, etc.

Development of waste management infrastructure should be financed from the State budget, from the budget of the local administration, by waste generators and from environmental funds. The Law on Industrial and Domestic Waste defines fees on waste delivered to disposal sites or stored on company premises Fees are defined as coefficients multiplying the minimum wage. If the waste amount exceeds that defined by norms on waste generation, the fee is increased fivefold. These fees constitute the income of the environmental funds.

However, the waste continues to be a major source of environment pollution in the Republic of Moldova, as long as some concrete measures are not taken in order to implement an adequate waste management system based on a legislative, normative and technical framework under the principles of the EU directives.

#### 15.2.4 Waste management system financing

Currently there are no data available.

### 15.2.5 Public awareness, education and communication initiatives

One of the obstacles on the way of the successful integrated waste management strategy implementation is the low public and business awareness on this issue. The National Waste Management Strategy (2013-2027) envisages the public participation as critical tool to perform and support waste management at national and regional levels. Despite the increasing complexity of waste issues and changes in waste treatment systems, all the waste management strategies necessarily require the involvement of households, businesses and civil society in a broad public consultation to reach strategic goals. The civil society slogan "only together we can have a clean environment" is a boost for collaboration and development of public awareness on environmental protection.

Moreover, the support of the international partners, including the European Commission, the International Financial Institutions and the Development Agencies, is vital for the realization of the development rhythm which is necessary for the approximation of European waste management practices.

The main objectives of the EU waste policy are to prevent waste generation and to promote its reuse, recycling and recovery in terms of environmental protection. Waste is becoming increasingly perceived as a source of valuable raw materials for industry, with approaches such as energy reuse, recycling and recovery, packaging waste regulation is applied, end of life motor vehicles, waste electrical and electronic equipment, biodegradable waste and waste tires. The European policy focuses mainly on the separation of biodegradable waste from deposits, recycling and recovery are increasing, it helps preventing environmental pollution and emissions of greenhouse gases.

### 15.2.6 Barriers and success factors for waste management performance

The following issues in the field of waste management were established by the NWMS as the key barriers in the implementation:

- the lack of (legislative, normative and technical) regulations on waste management that would be adequate to the current situation and the requirements of the EU legislation;

- the lack of an infrastructure that could plan, organize and implement an incorporated waste management system at all levels (national and regional);
- the lack of clearly defined responsibilities for each participant that is involved in the waste management process at the level of state institutions, associations, non-governmental organizations, the private sector, the civil society, etc.;
- the lack of adequate capacities for waste disposal and partial coverage with waste collection and transportation services in urban settlements (60 – 80%) and practically, the absence of these services in the rural areas (up to 10-20%);
- the lack of waste final storage facilities constructed and operated in accordance with the environment standards;
- the lack of toxic waste treatment facilities, including the medical waste, which are stored together with the municipal waste and therefore represent a high risks for the environment;
- the lack of administration infrastructure for other categories of waste, such as: construction and demolition waste, animal waste, street waste, etc.;
- the insufficient financing in the field of waste management, both at state and private levels;
- the weak implementation of the existent legislative and regulating framework in this very field, the implementation of minor penalties that encourage the infringement law;
- the lack of support and reduced participation of policy in the current waste management system.

To eliminate these issues the Government of Moldova should take the measures to make the policy more effective through establishing an institutional mechanism for the crucial co-ordination and extend it to other key stakeholders. The Ministry of Environment should ensure that the taxes have a clear environmental goal of changing producer or consumer behaviour. The Ministry of Finance needs to ensure that the taxes are compatible with the rest of the tax system. The Ministry of Economy should contribute with an analysis of the impact of taxes on resource efficiency and key economic indicators.

[11]

In order to facilitate the implementation of the strategy, more instruments, such as: regulation, institutional, economic and statistical development instruments, etc.

The regulation instruments will be completed and the legal framework related to the waste management activities will be improved, through: a) regulation acts on the activities of material and energy recovery; b) regulation acts related to the responsibilities of waste generators and goods producers that become waste (the principle of „responsibility of the producer“); c) regulation acts on the responsibilities of public authorities and the relationships to be defined between these authorities and other involved factors;

The institutional development is a vital condition for the implementation of the NWMS objectives and is a forebear in attracting the necessary levels of partnerships and investments. During the development of the strategy several options for strengthening institutional capacity at national, regional and local levels were evaluated proposed by international experts under the „Waste Governance“ Programme.

Simultaneously it is recommends to local authorities to create at regional level Waste Management Associations, which will jointly pursue the implementation of public investment projects of regional or regional interest in accordance with the regional Integrated Waste Management Strategies.

**Economic instruments:** The correct application of financial incentives on the one hand, and penalties, on the other hand, will encourage the management activities through prevention, reduction and recovery, by causing in the same time the disposal of management practices with impact on the environment or which contravene the principle „the polluter pays“. The economic instruments shall be elaborated with the aim of encouraging the reflection of the costs for waste management activities in the cost of the product and in order to divide out the burden of costs between the producers and generators of waste. The extended scheme on the responsibility of the producer for the flows of special waste will be studied and established by keeping the status of producers of products marketing, ensuring in the same time that the unjustified costs are not covered by taxpayers.

The statistical instruments will help to obtain real data on waste generation and that would allow the evaluation of the current situation and the estimation of trends for objectives establishment. The improvement and adaptation of the current system of collection, validation and reporting of data on waste management are necessary.

**Other instruments:**

- a) application and control of the enforcement of existent legislation;
- b) elaboration of regional waste management plans;

- c) intersector coordination of management activities of different types of waste;
- d) analysis of products life cycle and the realization of the „ecological balance” aimed to implement the best practices on waste management;
- e) education, change of behaviour and communication.

Build on existing best practices in Moldova. Rayons of the entire country should exchange experiences and establish networking structures to discuss: - models such as for inter-municipal cooperation in the SWM sector (the pilot region could be an example), and Recommendations

- private-public partnerships or similar models (e.g. the joint venture AVE Ungheni), lessons learned and successes of such partnerships.
- Foster knowledge sharing of best practices in Romania or other eastern European countries in rural areas with a functioning SWM system for all stakeholders (e.g. MoE, LPA2, LPA1, service providers, NGOs, among others) in order to understand:
  - how a SWM service system is developed,
  - how documents are created (waste strategies and plans),
  - which activities are done by civil society,
  - how actors in SWM cooperate,
  - which roles and responsibilities each stakeholder has, and
  - what are lessons learned.
- Provide internships or apprenticeships for managers of Moldovan service providers at well-functioning service providers abroad for various positions (e.g. management, accountant, waste collection and transport) at various locations (e.g. recycling yard, landfill and others). This would help managers get a better understanding of their roles and responsibilities.
- The SWM Technical Dimension
- Support reuse, recycling and recovering of waste. Besides awareness measures, lawmakers should give incentives for enterprises for resourcesaving usage of materials. The utilization of waste as a source for energy should be closely considered by the industrial sector.
- Provide occasional advisors at the local level to help restructure and reorganize the service provider and to advise LPA1 and LPA2 on how to foster inter-rayonal cooperation. Internal or external experts should train staff on how the new structure works.



- Inform service providers about their rights and responsibilities, especially as a community service provider.
- Awareness and Participation
- NGOs and other actors of SWM (e.g. service providers, SEI, NCPH, among others) should organize campaigns and other awareness activities jointly and with agreement or cooperation of local governments. NGOs should be encouraged to increase activities in this sector going beyond annual activities, such as cleaning days. Furthermore, LPA1 can support awareness in its locality in order to reduce littering and to increase the willingness to pay for adequate SWM services.
- Further clarify roles and responsibilities of all actors in the SWM sector. This creates transparency and accountability of each actor, avoids parallel structures and fosters cooperation.
- SWM services should be better positioned at the LPA2 level, with close cooperation from LPA1. Due to the extensive fragmentation of first-level administrative-territorial units, giving responsibility to the LPA2 level is more practical.
- Encourage inter-municipal cooperation as a model to help to overcome the limited capacities of LPA1. IMC requires an administrative structure, such as a waste management board, on the rayonal or inter-rayonal level.
- LPA2 should consider the population's willingness and ability to pay as well as how to support vulnerable groups in the creation of a financial model for this service system (and others). [12]

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## 16. Waste management situation in Georgia

### 16.1 Overall background

Georgia is a country in the Caucasus region of Eurasia. Located at the crossroads of Western Asia and Eastern Europe, it is bounded to the west by the Black Sea, to the north by Russia, to the south by Turkey and Armenia, and to the southeast by Azerbaijan (figure 64). The capital and largest city is Tbilisi. Georgia covers a territory of 69,700 square kilometres (26,911 sq mi), and its 2015 population is about 3.75 million. Georgia is a unitary, semi-presidential republic, with the government elected through a representative democracy.



figure 64: Geographic map of Georgia

After restoring its independence in 1991, post-communist Georgia suffered from civil and economic crisis for most of the 1990s. This lasted until the peaceful Rose Revolution, when Georgia pursued a strongly pro-Western foreign policy, introducing a series of democratic and economic reforms aimed at NATO and European integration. The country's Western orientation soon led to the worsening of relations with Russia, culminating in the brief Russo-Georgian War.

Georgia is a member of the Council of Europe and the GUAM Organization for Democracy and Economic Development. It contains two de facto independent regions, Abkhazia and South Ossetia, which gained limited international recognition after the 2008 Russo-Georgian War. Georgia and a major part of the international community consider the regions to be part of Georgia's sovereign territory under Russian military occupation.

Since the country gained its state independence in 1991 the population growth rate has changed dramatically due to acute political conflicts and economic crisis. Population reduction was largely caused by migration. Georgia lost around 20% of its population in 1990-2005. The biggest loss was recorded in 1993-1997 when the Georgian population decreased by one million. However, according to National Statistics Office of Georgia, as of 2002 the population of Georgia began to grow again and reached 4.5 million by 2014.

During the 1990s the population decreased in all regions of the country, but this process was more evident in mountainous regions, mono-industrial cities and in towns with large proportions of ethnic minorities (Armenians and Azeris).

Population density, types and sizes of urban and rural settlements vary considerably in different regions. Plains (which contain main transport routes and the most fertile locations) and the Black Sea coastal area are more densely populated while mountainous regions, especially the Greater Caucasus, are inhabited sparsely.

The most obvious example of uneven distribution is the concentration of a significant part of the population in Tbilisi. More than a quarter of the population officially lives in Tbilisi, and if the surrounding area (including Rustavi and Mtskheta) is taken into consideration the ratio is nearly half. [2]

The climate of Georgia is extremely diverse, considering the nation's small size. There are two main climatic zones, roughly corresponding to the eastern and western parts of the country. The Greater Caucasus Mountain Range plays an important role in moderating Georgia's climate and protects the nation from the penetration of colder air masses from the north. The Lesser Caucasus Mountains partially protect the region from the influence of dry and hot air masses from the south.

Pollution of the environment by wastes and chemicals is one of the environmental problems in Georgia. The problem is complex, comprised of littering of the environment, environmental pollution from landfills, and issues related to the management of hazardous and accumulated wastes.

Littering of natural landscapes and cultural sites with household wastes dumped without control is conspicuous in Georgia. This situation is problematic not only from the esthetic and economic points of view but also for the risks of diseases and parasite proliferation; both domestic and wild animals feed on the dumped litter that may poison them or result in accumulation of harmful substances in the tissues of the animals. The main reason for littering of the environment is the disintegration of the waste collection system. Presently, the regular collection of household waste is only carried out in big cities and district centers. In many settlements, (especially villages) the residents solve the waste problem themselves by dumping the wastes in nearby ravines, along the roads, or onto river banks. Eventually, these dumps are converted into small, uncontrolled "landfills."

The environment is significantly affected by air, groundwater and surface water pollution from improperly constructed official municipal landfills. Most of the 63 official municipal landfills operational today do not have a groundwater protection barrier and a leachate collection/ treatment system. Some of the landfills are located on riverbanks or water-tracing gorges, creating a risk for surface and ground water pollution. Almost all municipal landfills operating in Georgia today were constructed in Soviet times and they do not meet the current environmental requirements. Spontaneous, low-temperature combustion of wastes occurs in landfills, emitting harmful substances including dioxins and furans into the air. These persistent organic pollutants degrade slowly in the environment and are transported long distances by atmospheric flows. Presently - 7 municipal landfills (in Dedoplistskaro until 2013, Tbilisi, Rustavi, Khobi, Ureki-Natanebi, Ozurgeti and Gardabani near Rustavi) have obtained environment impact permits. Three of these landfills are owned by private companies (Ureki-Natanebi, Ozurgeti and one near Rustavi). Landfills in most municipalities do not have an environmental impact permit. The main cause for this is the limited financial resources coupled with the lack of the requisite knowledge, skills and guidance in meeting the environmental requirements. According to the amendment to the "Law on Environmental Permit" of 22 March 2011, already operational non-hazardous waste landfills must obtain a permit before 1 January 2014.

In Georgia, the reporting and control systems for production, transfer, treatment or disposal of the industrial, medical/veterinary and other hazardous wastes need improvement.

The environment is also polluted with accumulated wastes and sludge from mining and enrichment industries located in the areas surrounding former Soviet plants. Especially

dangerous is arsenic-containing ash and sludge in the villages of Tsana (Lentekhi Municipality) and Uravi (Ambrolauri Municipality) (on the territory of the former arsenic extraction and enrichment facility).

Obsolete agrochemicals also pose a threat to the environment, especially pesticides, which were left in large amounts after the breakup of the Soviet Union. Approximately 2,700 tons of hazardous chemicals are located in the damaged waste-burial pit at Iagluja hill. About 230 tons of obsolete pesticides were collected from the storehouses of former kolkhozes and sovkhozes all over Georgia and have been temporarily stored at the Iagluja burial. Their subsequent environmentally sound recovery and disposal is necessary. In addition, hazardous waste is produced as a result of agricultural activities, (empty containers of pesticides, agrochemicals, and obsolete pesticides from markets) and this issue needs to be adequately. [3]

There are no accurate figures about the quantity of solid waste in the country. Presently most of the municipalities cannot ensure collection of household waste from villages. Accordingly it is impossible to depict the real amount of generated solid waste in figures on the territories of municipalities. Neither is information available on the collection and re-processing of waste. According to a recent survey "Clean Up Georgia, 2012" one-third of solid waste is collected and placed on municipal landfills and the rest goes to unmanaged, spontaneously created landfills. There are few possibilities for collecting and processing of waste for re-processing purposes. Only a few small-scale waste processing plants (composting, plastics, glass, paper and other processors) operate in the country.

As for the capital city, the annually generated waste is approximately equal to the total volume of waste generated in the rest of the country. In addition, Tbilisi is relatively well provided with the relevant work force and equipment for collecting and placement of waste. However separation of waste at source is not carried out even in Tbilisi. Among the municipal landfills having an Environmental Impact Permit, only Tbilisi, Rustavi, Gardabani and Borjomi landfills meet international standards. Construction of Imereti and Kvemo Kartli landfills in 2014-2017 is agreed with international financial organisations. Projects for Kutaisi, Telavi, Mtskheta, Akhaltsikhe, Ozurgeti, Zugdidi and Ambrolauri landfills have already been implemented. It is planned that projects will be implemented for the construction of an additional 11 landfills. Georgia's household, Industrial, medical and hazardous waste management is regulated in accordance with the legislative requirements of various scattered laws and regulations. A framework law on waste management has not yet been adopted. One problem is the absence of statistical data on

industrial waste generated by enterprises operating in the country and their management. Moreover, there are almost no data about the amount and composition of industrial waste remaining from industrial activities of 1970-1980s. [2]

Currently there is no state inventory system for wastes in Georgia. Therefore, data on amounts of wastes generated annually, waste types, disposal, utilization and rendering harmless are practically absent. Very limited data are scattered among different agencies. These data are not digitized and accessible to different users. Due to the lack of financial and technical resources comprehensive waste inventories have not been yet conducted, nor the state register has been established which should include waste catalogue, inventories of wastes and their disposal sites, as well as databases on wastes and technologies of their utilization and rendering harmless. Similarly, there are no exact data on application of pesticides, amounts of obsolete pesticides and their storage facilities. The Department of Land Resources Protection, Wastes and Chemicals Management under the Ministry of Environment (MoE) has recently developed the state program on the inventory of obsolete pesticides and contaminated sites, but could not realize it due to the absence of finances.

Unified classification system is a set of statistical standards, making different management systems and databases compatible in terms of information. Without such systems it is impossible to conduct data collection, reporting, data processing as well as to achieve data compatibility at the international level.

Waste classification is one of the major components of the unified classification system and is aimed at supporting decision-makers with information in the fields of waste management and natural resources use, on the basis of record keeping and reporting in accordance with international standards.

Currently, Georgia is moving towards adoption of new system of data collection and statistical reporting. The transition is being conducted from sector-based to enterprise-based (sourcespecific) statistics. Because of that, new formats and methodologies for data collection and reporting are being elaborated based on international requirements.

Waste classification system existing in Georgia is based on Soviet approach, which divides wastes into five classes according to level of hazard (toxicity). These five classes are ranging from extremely toxic to non-toxic classes. However, there are neither exact criteria for the classification of waste types nor definitions for a "hazard".

At present, the State Statistical Department is working towards the development and setting up of modern national system of classification, waste classification being one of

the parts of it. The document will have a regulatory status and its application will be mandatory for all users. Under this system, all types of wastes (either substances or items) and services related to them are subject to classification. The source of origin (genesis) and the level of hazard serve as criteria for setting waste classification system, the first being the major criteria. As an initial step towards setting new classification system, comprehensive waste inventory should be conducted throughout Georgia and waste catalogue developed. This catalogue should serve as a basis for the development of national standard on Waste Classification System. Unfortunately, the catalogue has not yet been developed, hindering the timely adoption of waste classification system.

Under the suggested scheme, major classification criteria for wastes will be the source of origin (raw material, economic activity and technological process). The level of hazard will be added to above criteria. The system will cover the whole life cycle of waste management and will be compatible to the National Classification System on Economic Activities, based on European standard NACE. The structure of the system will be divided into two parts. The first part will classify all wastes and the second – services related to these wastes. The classification code will consist of eight-digit number (XXXX \* X \* X\* XX) for both wastes and services. The code for wastes will take into consideration economic activity, the phase of process, the type of process and the type of waste.

### 16.1.1 Country profile

Georgia is located between the Black Sea and the Caspian Sea and is comparable in area to the Irish or Czech Republics. Georgia is divided into 9 regions, 1 city, and 2 autonomous republics. These in turn are subdivided into 69 districts.

Georgia contains two official autonomous regions, of which one has declared independence. In addition, another territory not officially autonomous has also declared independence. Officially autonomous within Georgia, the de facto independent region of Abkhazia declared independence in 1999. South Ossetia is officially known by Georgia as the Tskinali region, as it views "South Ossetia" as implying political bonds with Russian North Ossetia. It was called South Ossetian Autonomous Oblast when Georgia was part of Soviet Union. Its autonomous status was revoked in 1990. De facto separate since Georgian independence, offers were made to give South Ossetia autonomy again, but in 2006 an unrecognised referendum in the area resulted in a vote for independence.



Historically, it has been an important crossroad for international trade and still is a significant corridor for oil and gas transit. The Baku - Tbilisi – Ceyhan oil pipeline and the South Caucasus gas pipeline go across southern regions of the country and play an important role in Europe's Energy Security Policy. In addition, the planning and implementation of new projects to transport energy resources in an east-west direction through the country is quite promising.

The border with Russia to the north runs along the Greater Caucasus mountain range, with a height of 5000 meters. The southern border that separates the country from Turkey and Armenia lies on the Lesser Caucasus and the Javakheti Upland. The Greater Caucasus has always been a symbol of national and cultural identity. Moreover, the Caucasus Mountains offer hydroelectric and woodforest resources as well as tourist potential.

The western boundary of Georgia is formed by the Black Sea coast, while in the east the country is bordered by Azerbaijan. In spite of the fact that during the last century, the large part of lowland forests was cut down due to rural and urban development, 40% of the total area of the country is still covered by forests.

Georgia has important hydro-energy resources (that meet most of the overall energy requirements of the country). A variety of mineral waters in different varieties are also available, some of which are internationally recognised and are notable for successful commercial usage. At various times manganese, copper, gold, silver and iron have been successfully obtained in Georgia.

The endeavors for introducing an environmental protection planning system in Georgia began in the late 1990s. Recognizing the complexity of environmental issues and the need for reflecting environmental aspects in economic development, human health and social welfare sectors, the framework Law on Environment Protection (LEP) was enacted in 1996. The LEP requires preparation of the national Strategy for Sustainable Development (SSD) and mandates the Ministry of Environment Protection Georgia to lead this process. By the same law, the drafting process of National Environmental Action Programme is organized by the Ministry of Environment Protection based on the Strategy for Sustainable Development. The Strategy for Sustainable Development has never been developed. The LEP also says that a National Environmental Action Programme (NEAP) should be prepared every five years. A National Commission for Sustainable Development was established in 1996 by presidential resolution, but has failed to develop a Strategy, and the Commission was abolished in 2005. A similar Commission was

reconstituted the same year by governmental resolution but the SSD has still not been developed. [4]

### 16.1.2 Development of economic and environmental situation

The economy of Georgia is an emerging free market. Its gross domestic product fell sharply following the collapse of the Soviet Union but recovered in the mid-2000s, growing in double digits thanks to the economic and democratic reforms brought by the peaceful Rose Revolution. Georgia continued its economic progress since, "moving from a near-failed state in 2003 to a relatively well-functioning market economy in 2014". In 2007, the World Bank named Georgia the World's number one economic reformer, and has consistently ranked the country at the top of its ease of doing business index.

Georgia's economy is supported by a relatively free and transparent atmosphere in the country. According to Transparency International's 2015 report, Georgia is the least corrupt nation in the Black Sea region, outperforming all of its immediate neighbors, as well as nearby European Union states. With a mixed news media environment, Georgia is also the only country in its immediate neighborhood where the press is not deemed unfree.

Since 2014, Georgia is part of the European Union's Free Trade Area, with the EU continuing to be the country's largest trading partner, accounting for over a quarter of Georgia's total trade turnover. Following the EU trade pact, 2015 was marked by further increase in bilateral trade, whereas trade with the Commonwealth of Independent States (CIS) decreased precipitously.

The recession in Russia and slower growth among other trading partners impacted Georgia through lower exports and reduced remittances, particularly from Russia and Greece. The tradable sector suffered the most, with industrial production contracting by one percent in 2015. As a result, growth moderated from 4.6 percent in 2014 to 2.8 percent in 2015. With a decline in external performance, the current-account deficit widened to 11 percent of GDP, and the Lari lost 30 percent of its value since December 2014. The tightening of monetary policy together with lower oil prices helped contain inflation during 2015 to 4.9 percent. Prudent financial sector supervision ensured stability of the banking sector and low level of NPLs at 2.3 percent in 2015. In an environment of weak external demand and high policy rates, the government supported growth through a 17 percent increase in capital expenditures.

Despite the overall slowdown, growth was supported by non-tradables such as construction, which grew at 16 percent, and services with growth of 3 percent. Foreign direct investment (FDI) and tourism proceeds remained stable, which also helped increase employment by 20 percent and real wages by 4.7 percent in 2015. The largest increases in wages were in construction, real estate, and health.

With Parliamentary elections scheduled for October 2016 and the weakness in external markets likely to persist, growth is projected at 3 percent in 2016. Georgia's anticipated adoption of the Estonian tax model would replace the corporate profit tax with dividend tax: while this measure could boost medium-term growth, tax revenues will decline immediately and could increase the fiscal deficit by up to 2 percentage points of GDP by 2017 (IMF estimate). Slow growth, a large current-account deficit, high levels of external debt (over 100 percent of GDP), and a widening fiscal deficit are the main macroeconomic challenges faced by the country. [5]

Like other republics of the USSR, Georgia suffered severe environmental degradation during the Soviet period, when economic policies emphasizing heavy industry were implemented with little regard for their environmental consequences. Significant amounts of agriculture lands have been lost in land erosions. As a legacy of these policies, Georgia now suffers from serious pollution. Municipal waste is disposed in poorly managed landfills. Air pollution is a problem in the major cities, particularly in Rustavi, which has a giant steel plant and other metal and chemicals production. Traffic is another great contributor to the pollution of an air. Furthermore, the Kura River and the Black Sea are heavily polluted with industrial waste. As a result of water pollution and the scarcity of water treatment, the incidence of digestive diseases in Georgia is high.

Due to low production and low economic development, the industrial waste has significantly decreased during late 1990s and early 2000s, however at the moment there are no industrial waste treatment facilities, therefore all the waste produced is being disposed into the environment without a treatment. The use of pesticides and fertilizers has increased soil toxicity as during 1980s up to 30,000 tons of pesticides have been used in Georgia annually.

The biggest threat to the environment are over 2,5 tons of hazardous chemicals that have been buried at the Mt. Iagluji, at the depth of 20 meters, over 10 years, since mid 1970s. Georgia does not energy resources and it is dependant on Russian gas and oil. Environmental protection did not become a major concern among Georgians until the mid-1980s, but even then systems to control harmful emissions were not readily available. Georgia's economic problems have hindered the application of recent emission-

control technologies. Hardship and low life quality forced people to over use natural resources, particularly firewood. The protection of upland pastures and hill farms from soil erosion is another pressing issue that the government has not addressed owing to lack of economic resources. The government has ratified international environmental agreements pertaining to air pollution, biodiversity, climate change, ozone layer protection, ship pollution, and wetlands.

Global warming has quite similar effects on all high mountains, therefore Caucasus region faces the same threat as, for example the Alps, in Europe, the Rocky Mt. in the USA, the Andes of south America or Kilimanjaro Mt. in east Africa. Glaciers in North Caucasus have retreated for 50% in the 20th century, with most drastic changes since 1998. Melting of snow and ice sheet changes the water regime within the region, where most people depend on reserves of water preserved in glaciers over winter, which are being released during the summer, depending on hydropower of rivers formed by glaciers, and their contribution to agriculture. Avalanches on Caucasus always posed a threat, however, with the higher average temperatures, melting snow may cause these catastrophes to occur much more frequent.

Followed by these habitat and ecosystem changes, biodiversity of Caucasus is vanishing. This region is known as biodiversity hotspot, teeming with life, since it represented one of the greatest European refugium for species, during The Great Ice Age. Today, life in Caucasus is threatened with both direct human activity within the area, and global consequences of human activity, such as greenhouse gases emission and warming. [6]

## **16.2 Waste management situation in Georgia**

The waste management situation in Georgia before 1990 subjected to the same principles, rules and regulations as for the other countries of USSR, described in the Section 11.2. There is the same lack of information on legislation and technologies used which could help to evaluate the results of the waste management by that time. But even regardless the possible positive results during the Soviet time, the process in 1990s, deep economic recession and lack of financing caused the dramatic damage to the existed system and the necessity to practically restore the system from the beginning.

### 16.2.1 Legal and institutional framework of waste management

The Law on Environmental Protection (1996) sets a legal framework in the fields of environmental and natural resources protection in Georgia. It defines general objectives of environmental protection, as well as the principles, guidelines and mechanisms for their implementation. It also defines rights and duties of citizens and responsible authorities and sets criteria for division of responsibilities among these authorities. The law requires that industrial facilities conduct an integrated pollution control and monitoring as well as develop emergency preparedness and response plans in agreement with designated authorities. According to the law, new owner of a company should meet environmental requirements, which were set for former owner. All new industrial and commercial developments, as well as major industrial modifications are subject to environmental permitting issued by designated authorities. Laws on Environmental Permits (1997) and State Environmental Examination (1997) regulate significant potential impact on environment imposed by human activities, through Environmental Impact Assessments (EIAs), State Environmental Examination (SEEs) and issuance of integrated environmental permits. The Ministry of Environment of Georgia grants environmental permits provided the applicant will suggest mitigation measures and meet all environmental standards and requirements. The applicant is responsible for carrying out of EIA and the MoE – for carrying out of SEE. EIA and SEE costs are covered by the applicant, as part of the cost of permitting process. The law guarantees public participation in all stages of EIA.

The Law on Waste Management has not yet been adopted in Georgia. A draft law is now under consideration by the Georgian Parliament. Among other major goals, the law aims at establishing of state waste management system and promoting of gradual introduction of EU standards and requirements in this field. It regulates generation, collection, transport, recycling, reuse, disposal, rendering harmless of municipal, and hazardous wastes. The law sets waste classification and inventory systems.

Under the law, wastes are classified according to their source of origin, as well as according to health and environmental hazards. Based on source of origin there are five types of wastes: Municipal wastes; Industrial wastes; Medical wastes; Agrochemical wastes; Biological wastes.

The group of hazardous wastes is separated from all above types of wastes. Any types of wastes are designated to be hazardous if they contain hazardous substances defined in appropriate Georgian laws (Law on Hazardous Substances). Hazardous wastes are

divided into sub-groups based on type of hazard (teratogenic, cancerogenic, toxic, etc.). However, the law does not define the threshold for "hazard".

The law requires the keeping of national waste catalogue, where all wastes should be registered by using of six-digit trade codes set in Foreign Economic Activity Trade Code System. In addition, wastes can be described according to waste registration and coding systems laid down in Basel Convention and #259/93/EEC directive. State waste catalogue should be maintained according to classification system set under this law as well as according to waste classification system set in the European Waste Catalogue approved by the #2000/532/EC decision in accordance with #/75/442/EEC and #/91/689/EEC directives. Waste identification should be conducted according to the national rule on waste identification, which should be based on waste identification requirements laid down in #2000/532/EC EC decision. Before the rule is adopted, wastes should be identified in accordance with Basel Convention and EU #259/93/EEC directive, as well existing national standards, sanitary-hygiene norms and rules and relevant Georgian laws. All types of wastes listed in yellow and red lists of EU #259/93/EEC directive, are classified as hazardous.

The law on Waste Management requires that the country set-up and keep the state system of waste inventory. Under this system, waste generators should conduct waste inventories at source and in an approved format and rule, on a regular basis, report to designated authorities (MoE and State Statistical Department). All this information should be gathered in State Waste Register, which should include qualitative and quantitative information on waste generation as well as information on waste sources, based on technological processes. The classification of waste sources should be based on the national classification system as well as on the economic activities identification and coding system laid down in Economic Activities National Classification Catalogue.

The law on Waste Management does not designate one specific management authority in the waste management field. It requires the setting of state steering committee under the Ministry of Environment for coordination of waste management activities for all types of wastes.

Other major laws in the field of waste and hazardous chemicals' management are as follow:

- The Law on the Transit and Import of Wastes Into and Out of the Territory of Georgia (1995, Amended in 1997) regulates the movement of "green", "amber"

and “red” list wastes through Georgia. It bans import and transit of hazardous and radioactive wastes in Georgia;

- The Law on Hazardous Chemical Substances (1998) sets the legal and institutional base for chemicals safety management. It requires registration of hazardous chemicals, licensing of new chemicals and keeping of database on chemical registration, use and storage. In addition, the law contains provisions on the permitting of import/export of chemical substances. The ministry of Health is a major responsible authority in the chemicals' management field, among others having the responsibility to set-up and maintain the state register on chemical substances and, jointly with the Ministry of Environment share co-responsibility in the field of chemicals safety management.
- The Law on Pesticides and Agrochemicals (1998) regulates import, production, transportation, storage and usage of agrochemicals. Among others, it requires the examination and registration of new agrochemicals, keeping of the list of allowed chemicals, development of the state catalogue on agrochemicals and setting-up of the state register on agrochemicals by the Ministry of Agriculture and Food or its subordinated bodies. Banned pesticides are regulated under the Law on Hazardous Substances, by the provisions on the ban and restriction of hazardous substances.
- The Law on Radioactive Safety (1998) sets legal framework in the field of nuclear and radioactive safety. Among others, the law contains provisions on the inventory of radioactive wastes and their sources. Specifically, Nuclear and Radiological Safety Service, MoE is responsible for keeping the state register on radioactive wastes and their sources, which should include data on existing nuclear and radioactive facilities, quantities of radioactive substances used as feedstock, radioactive substances and wastes imported, exported, used or generated and locations and technical conditions of their storage and disposal facilities. Owners/operators of nuclear and radioactive facilities, holding the licenses are responsible for radiation operational control and measurements of ambient pollution levels. Along with this, they are responsible for conducting inventories at source, keeping records on their activities, technical parameters of facilities owned/operated, quantitative and qualitative parameters of radioactive substances and wastes, used or/and generated, etc. and annual reporting to MoE. State register maintained by MoE should be based on these reports.

Georgia is a party to the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal. Recently it signed the Stockholm Convention on Persistent Organic Pollutants and GEF-funded enabling activities to develop National Implementation Plan and ratify the convention are currently underway. In addition, preparatory works are being conducted within the Ministry of Environment to accede the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade.

The Ministry of Environment Protection of Georgia (MEP) is a key institution at the national level dealing with surface water-related issues. MEP is responsible for the state management and protection of surface water as well as for setting up water monitoring systems. Other water-related responsibilities are scattered among different state institutions.

The Ministry of Labour, Health and Social Affairs of Georgia (MLHSA) is responsible for defining policy that ensures a safe environment for the public health. Specifically, the MLHSA develops environmental quality standards, including those for drinking water, surface waters, and groundwater.

The Ministry of Regional Development and Infrastructure of Georgia (MRDI) is responsible for implementing regional development policy including coordination and support of the development of water supply and sanitation systems in the regions of Georgia. The Ministry also manages the 100% state-owned water service company Ltd United Water Supply Company of Georgia.

The Ministry of Agriculture of Georgia is responsible for monitoring, supervision and state control over drinking water safety parameters and compliance with established drinking water quality standards. The Ministry of Energy and Natural Resources (MENR) issues licenses for natural resources consumption.

Local Self-Governance Institutions are responsible for the management of water resources of local importance but they generally have very limited competences; water management is highly centralized. [4]

Several agencies are involved in waste and chemicals management in Georgia. Their responsibilities are not stated clearly and delineated from each other. There is little cooperation among them and limited data kept by these agencies are not shared or exchanged. The Ministry of Environment is responsible for developing and implementing national waste management policies, strategies and regulatory documents, as well as for enforcing existing norms and standards for environmentally sound disposal and



treatment of industrial and municipal wastes. The Ministry is also responsible for implementing international treaties in waste management field, specifically the Basel Convention. The national focal point, who at the same time is a deputy head of the Department of Land Resources Protection, Waste and Chemical Substances has a primary responsibility for coordinating activities under the Convention.

- The Department of Land Resources Protection and Waste Management consists of three divisions handling with land protection, wastes and chemicals. Two staff, not enough for effective waste management deal wastes and Chemicals. The department gathers information on contaminated sites, industrial and municipal wastes and chemicals. Major sources for information on land contamination are MoE local authorities, MoE analytical labs (land contamination by pollution sources) and Hydromet (data on ambient pollution). MoE regional departments gather information on industrial wastes. They use standard questionnaires, prepared by the Department and to be filled out by owners/operators of industrial facilities. City municipalities and MoE local authorities are the main sources for information on municipal wastes. Regarding the chemicals, MoE regional authorities gather information within the regions, while central office collects data from the Ministry of Health, responsible for the maintaining registers on hazardous substances, and the Ministry of Agriculture, responsible for the maintaining state registers on agricultural chemicals and fertilizers. Information is collected via special questionnaires, developed by department's staff. Information is collected upon requests made by the MoE to other data collecting authorities. There are no legally binding reporting requirements for wastes. Existing data are not entered in computers and are stored in paper formats.
- Nuclear and Radiation Safety Service coordinates and carries out an inventory of radiation sources and radioactive wastes at former Soviet military bases and plans measures for their rehabilitation. It has a staff of 10 people, which is not enough for effective performance by the Service.
- The Ministry of Economy, Industry and Trade is responsible for licensing export and import of ferrous and non-ferrous scrap and other industrial wastes. The Ministry of Labor, Health and Social Affairs is responsible for setting and enforcing sanitary-hygiene standards, including soil and food product standards. It also is responsible for setting-up and operating state register on hazardous substances.

- The Ministry of Agriculture and Food is responsible for coordinating activities in agrochemicals management, including state inventory of agrochemicals, development of agrochemicals catalogues and approval of the list of permitted agrochemicals.
- Municipalities and local governing bodies are responsible for collection and disposal of municipal wastes, as well as providing information on this category of wastes.

State Statistical Department is responsible for setting-up and operation of national system of classification, including waste classification. Jointly with the State Department of Standards and Metrology it develops regulatory documents for national classification, coordinates national classification activities, publishes and distributes national codes of classification and related regulatory-guidance documents. Apart from this, the agency is responsible for maintaining and reporting of national statistics on all social and economic indicators, including environmental indicators. State Department of Hydrometeorology through the National Center for Ambient Environmental Monitoring is responsible for regular collection of data on soil contamination on agricultural lands and in industrial areas. The Center has an analytical laboratory for soil analyses. At present soil quality monitoring is not conducted due to financial shortage. [3]

### 16.2.2 Development of waste management situation and infrastructure

There is no tradition for regular waste monitoring in Georgia. Even inventory of the household, industrial, medical, or chemical wastes is carried out only in some exceptional cases and depends on available resources of a specific project. The reason for this situation is the lack of waste related national legislation. A national law on waste has still not been adopted; neither is there any national strategy, action plan, or a policy on waste inventory. The 1996 Framework Law on Environmental Protection establishes the principle of minimization of waste (in the implementation of the activity, priority is given to technology that ensures the minimization of waste) and the principle of recycling (in the implementation of the activity, priority is given to such materials, substances and chemical compounds, which may be reused, reprocessed, decomposed or degraded biologically without damaging the environment).

In the frame of international UNDP project in 2007 was carried out waste inventory on the territory of Georgia. The data corresponds only to the sites where the inventory has been carried out, and they correspond to only a fraction of the total industrial waste. Moreover, although the questionnaires tried to capture the volume of waste generated per annum and the amount of waste stored at the industrial sites, the final results do not clearly distinguish between these two types. Data is hence to be dealt with care and provide only an order of magnitude estimate. During the implementation of waste inventory project, the main focus was made on stationary sites, having potential of generating substantial volumes of waste.

Based on the data provided by the National Statistics Service, there were 4,632 reported industries in Georgia. 192 out of them are large, 497 medium and 3,943 small in 2005. The number of industries has significantly grown since 2005; evident updated data is essential. The main industrial regions are the same as was reported namely: Tbilisi, KvemoKartli, Imereti, ShidaKartli and Kakheti. Main polluting industries are located in these regions.

The above mentioned inventory states that 908,740 tons of accumulated industrial wastes are considered hazardous waste. Moreover, thousands of tons of waste from metallurgical, ferroalloy, mining and other industries, such as slag and gobs, were accumulated in industrial cities during the Soviet period. Some of those industries are currently not operating, and others have changed activity, but the waste remained in their premises. These sites still constitute hotspots with high concentrations of toxic waste, and no information exists on the amount and characteristics of waste present there.

According to the inventory report the data is based on estimates provided by the owners of the sites. There is no information regarding the toxicity of accumulated waste, their physical state and chemical composition. Evident the lack of updated information required for monitoring and controlling the industrial waste produced and managed. The inventory is weak on the part of commenting on issues of disposing, processing, recycling or sterilising the wastes. Consequently an inventory of industrial wastes and an overall waste management information system in Georgia are essential. [7]

### 16.2.3 Legal and economic instruments to support waste management hierarchy

#### Solid waste collection and transportation

The field of municipal solid waste management is coordinated by sakrebulo infrastructure commission, which is authorized to make decisions at a local level, approve budget, and supervise purposeful expenditure of the budget.

In Georgia, municipal solid waste management service is carried out by cleanup services existing at local governments, which mainly are governmental establishments or limited responsibility companies, in which the state holds 100% shares. Because of scarcity of material and technical basis, these establishments can manage only 25-35% of total amount of generated waste, what is limited only by collection and disposal mainly at not managed landfills. According to preliminary, unverified data, 80% of total amount of the waste generated in Georgia comes on population, 15% on the business, 3% on spontaneously dumped waste, and other 2% on all other sources. As for the waste collection scheme, it is almost the similar in all regions, and consists of three main systems:

- Container, which means dislocation of plastic and metal containers of small and average size (from 0.24 liters to 1 cubic meter) in the streets of populated areas, from where the lorries carry out collection and transportation of the waste in the intervals determined by each municipality to existing landfills;
- Bunker, which is used mainly in cities, where multi storey residential houses exist, and envisages getting accumulated waste out of the entrance bunkers within the certain intervals. It has to be mentioned, that recently many cities have refused use of such a system;

So-called "bell" system, which envisages riding the yards with a waste lorry and collecting the waste directly from population.

According to baseline data, the most widespread system in municipalities is the container system, which constitutes 74%, and then the bunker system comes with 16%, and, finally, the "bell" system with 10%.

It should be noted that in a whole the municipalities (municipal services, limited companies) do not have adequate amount of equipment and workforce involved in the field of waste collection. For example, according to basic data, in Georgia from 85 populated areas in total 5261 people are employed in collection of the waste. However, the vast

majority of people come from Tbilisi and large cities (Tbilisi – 3200, Rustavi – 270, Batumi – 80, Kobuleti – 120, Ozurgeti – 150, Zugdidi – 90, Marneuli – 105, Gori – 80, Khashuri – 70). It is clear that in these regions there is obvious lack of trained staff.

As for collecting equipment, in the field of municipal solid waste there are in total involved 209 dust-trucks, 190 compaction dust-trucks (of whom 153 are in Tbilisi, and 26 in Rustavi), 10 dump trucks and 3 motorcycles. It has to be mentioned that waste collecting equipment is obsolete or amortized especially in the regions and requires renovation. Special attention deserves motorcycles, which are used in Signagi and Samtredia, as in many cases the motorcycle is the best solution for collection of the waste, especially in such residential areas, where a lot of narrow and inaccessible roads exist. At the same time, motorcycle is much cheaper compared with the lorry. In the regions, lack of waste containers is also notable. According to baseline data, in all municipalities there are in total 17878 metal and 8223 plastic containers. However, just as in previous case their majority are located in Tbilisi and other large cities (Tbilisi – 10000 metal units, 4000 plastic ones; Rustavi – 560 metal units; Batumi – 1178 metal units, 1244 plastic ones; Kobuleti – 400 metal units, 600 plastic ones; Ozurgeti – 500 metal units; Zugdidi – 450 metal units, 500 plastic ones; Zestaphoni – 107 metal units, 60 plastic ones; Gori – 447 metal units, 23 plastic ones; Khashuri – 100 metal units; Kaspi – 136 metal units; Borjomi – 260 metal units; Mtskheta – 410 metal units, 20 plastic ones; Sagaredjo – 260 metal units; Lagodekhi – 200 metal units; Akhmeta – 228 metal units, 18 plastic ones; Dedoplistskaro – 300 metal units).

According to baseline data, total amount of the waste collected daily is 8186.3 cubic meters, monthly this number reaches 269166.1 cubic meters. These data cannot be considered as correct, as, unfortunately, there are no exact data of the waste inventory available. Exactly the absence of proper inventory of the waste is one of the problems existing today in the field of municipal solid waste management. Much worse is the situation in the areas far from administrative centers, where practically no containers exist and collection and removal of the waste is either badly organized or absent at all, which by itself causes pollution of woodlands, ravines, and riverbeds by different types of waste. The above-mentioned points at the fact that municipalities do not have any united municipal waste management plan, where necessary equipment is registered, number of workforce, collection schemes for particular places, clear procedures, logistical plan and operations plan is present. No integration with other systems such as, for example, spatial development, urban planning, land management, etc., occurs and the analysis of

expected activities does not exist at all. Proceeding from this, it is possible to make the list of basic problems in the field of municipal solid waste collection and transportation:

- lack of qualified personnel;
- lack of adequate equipment (motorcars and other collection equipment);
- lack of containers;
- lack of waste inventory;
- lack of municipal solid waste management plan.

### Landfills

Landfills are generally one of the most problematic issues in the field of waste management. All official landfills registered in Georgia belong to the municipalities hence the municipality takes responsibility for its legality, sanitation control, and care.

According to existing data, there are 63 landfills officially registered in Georgia (information of the Ministry of Environment). Apart from that, many illegal, spontaneous locations of the waste are notable, which, just as the majority of legal landfills, are mainly located near populated areas, motorways, natural water reservoirs, and in most cases in the riverbeds and bottoms of ravines.

On the grounds of baseline data, landfills occupy in total more than three hundred hectares, from these 203 hectares are active landfills. Among regions, the largest area is occupied by the landfills in Imereti (100 hectares), then come Tbilisi (80 hectares), Kakheti (58 hectares), Samegrelo (41 hectares), Kvemo Kartli (28 hectares), Adjara (19 hectares), Shida Kartli (18 hectares), Samtskhe-Djavakheti (11 hectares).

As a result of special processing of this information, the maps of volumes of municipal solid waste disposed whether legally or illegally have been created within the framework of the project. At the same time, the map prepared in GIS has also been created, where information regarding municipal solid waste is reflected.

The amount of the waste disposed at landfills comes into controversy with collection data. According to these data, 22716 cubic meters of waste will be disposed daily at the landfills, whereas the volume of the waste collected daily in the same municipality is 8186 cubic meters. The same applies to the rate of monthly disposal, respectively 82560 cubic meters and 269000 cubic meters.

Almost all official landfills operate back from Soviet times and correspond to those-time standards and norms, which today are already obsolete and unacceptable, while they have been operated since those times inadequately. On the whole, only 22 landfills are fenced, in some cases "partly", and the security is located at 21 landfills, although the issue of safety is arguable. Only 16 landfills have good access and internal roads, while in other cases moving on the territory of the landfill is practically impossible, especially in rainy weather. In total 283 people, 9 bulldozers, and 14 excavators are employed on the average at the landfills. It is impossible to rely on these data because of lack of baseline information.

In 2007, the Law on Environmental Impact Permit entered into force. According to the Law, all operating companies of landfills are obliged to prepare and approve EIA report, based on which the Ministry of Environment of Georgia issues the permit for environmental impact. Obtaining of corresponding documentation confirming their legality proved impossible at either of the landfills. The validity of the landfills is also uncertain. The exact term of functioning of the landfills is known only in a number of cases. In majority of cases (except for new landfills of Tbilisi and Rustavi) there is no landfill construction design presented, neither EIA nor environmental impact permit. There is no plan and/or disposal procedure, and waste inventory occurs nowhere. Only at 18 landfills the existence of environmental monitoring is reported, which is quite suspicious, especially as it has not been possible to submit corresponding documentation, although existence of the network of observation boreholes is observed at 50 landfills. One more problematic issue is landfill scavengers, people, who collect different materials and products at the landfills with the purpose of their further selling. These people are considered being in a high risk health group, just as they impose danger to the health of others because of spread of different infectious diseases. This phenomenon is of more social nature, since people engaged in this activity are below poverty line. Proceeding from above-mentioned, the main problems connected with landfills can be formulated as follows:

- absence of private landfills;
- existence of illegal, spontaneous landfills;
- lack of landfill infrastructure (fencing, security, internal road, weighing machine, other helping facilities and etc);
- lack of qualified personnel;
- lack of corresponding documentation;

- incompatibility with sanitation norms and rules;
- lack of landfill construction design;
- insufficient location of landfills (near riverbeds, populated areas, absence of watertight layer, spontaneous inflammation etc);
- absence of environmental impact permit;
- absence of environmental control and monitoring;
- absence of waste inventory.

All above-mentioned problems can be easily addressed through creation of corresponding legislative base and development of municipal solid waste management plans, which actually mean development of integrated sustainable waste management system. [8]

### Recycling

In Georgia, the recycling business is being developed slowly. There are facilities for processing only paper, glass, several types of plastics, and for extracting lead from car batteries. The development of a secondary materials industry and market is anticipated in the near future.

In Tbilisi, the annual per capita household waste production is 50% less than that in the average European household. The economic development of the country is expected to cause increased waste generation rates necessitating the development and implementation of waste minimization (for example, facilitation of multi-use packaging), waste separation and recycling programs.

Industrial development resulted in increased use of industrial chemicals and generation of more hazardous wastes. Though development of certain sectors will support the improvement of the respective waste management. For example, modernization of healthcare facilities will create favorable conditions for improved medical waste management. Georgia has a number of international obligations in the field of waste management. In order to meet those obligations, specific projects aimed at resolving the waste management-related problems have been implemented in Georgia.

Georgia also participates in the implementation of the Strategic Approach to the International Management of Chemicals (SAICM). The National Chemical Profile and SAICM capacity assessment have been developed. Assessment of the institutional capacities



for establishment of Pollution Release and Transfer Register (PRTR) in the country is underway.

On 21 April 2011, the “National Action Plan on Persistent Organic Pollutants” was approved by the Governmental decree #907. The Plan envisages implementation of the obligations of the Stockholm Convention on “Persistent Organic Pollutants”. [4]

#### 16.2.4 Waste management system financing

Today in all regions of Georgia one type of municipal fee exists, which is called cleaning fee. Legislative body of each municipality and sakrebulo (assembly) establishes the amount of cleaning fee by its decision for a particular municipality. The payment is determined in accordance with active legislation of Georgia. Its withdrawal is also determined by the legislation, although in many cases the total withdrawal of the payment is impossible. Because of this, the income of the municipality is also unpredictable.

The large part of the sum coming from the fees is applied directly to cleaning, collection of the waste, and its final disposal.

As we have mentioned, limited companies carry out cleaning of municipalities, in the majority of which 100% belongs to the state. These companies are fully subsidized by the state, and are not responsible for collecting the fees. The budget allocated for municipal solid waste management is largely low and does not correspond to requirements of modern waste management, since quite substantial sums are needed for the introduction of new technologies and purchase of equipment.

One of the most effective instruments for sustainable waste management is close partnership between three sectors – state, community, and private sector, which envisages involvement of much larger part of private sector into the service cycle. This will cause sound competition between private companies at the waste management market, which, in its turn, will have positive effect on reduction of prices and improvement of service quality. This time the role of society is monitoring of management process, while that of local government is control and inspection. In order to make municipal solid waste management business attractive to private sector, it is necessary to have adequate support and motivation from the state, which at least in the initial period will be expressed through cheap credits, tax benefits and different type of subsidies, without which it is impossible to attract investment in this field.

It is also to be mentioned that imposition of the payment by private sector should occur under strict control of the state, since extremely high payment can make population again illegally “throw” the waste, which itself will cause the growth of number of spontaneous landfills. [8]

#### *International Support in Environmental Protection in Georgia*

The main partners of Georgia in the field of environmental protection are the European Commission, GEF, KfW, OSCE, USAID, the World Bank and the Government of Germany, Japan, the Netherlands and Norway.

These are just few projects which provides the technical support to the Georgia in the waste management sector:

#### **Waste Management Technologies in Regions (WMTR) – USIAD;**

The Waste Management Technologies in Regions activity will improve policy formulation and strategic planning related to waste management at national and local levels in Georgia; enhance the capacity of targeted municipalities to establish and maintain sustainable waste management facilities and services; and support the development of Georgia’s recycling sector. The program will develop remediation plans for old and illegal landfills, which will improve management of thousands of hectares of biologically rich areas. The activity will help reduce environmental pollution, improve sanitation and human health, and increase the quality and quantity of recycled products.

#### **Georgia Solid Waste Management Project – EBRD;**

The project will support overall improvement of waste management practices and enhance people's daily lives by reducing health hazards caused by unsanitary waste handling. The Environmental and Social Due Diligence (ESDD) has been conducted by EBRD's staff and focused on a review of the PIU - Georgian Solid Waste Company's existing Environmental and Social management systems, as well as an analysis of environmental and social impacts and benefits associated with the project to ensure the proposed specifications for the equipment will meet EU requirements. The ESDD also included visits to some municipalities and solid waste facilities to access the current environmental and social (E&S) practices. It has been concluded that the project can be structured to meet EBRD's E&S requirements and an Environmental and Social Action Plan

(ESAP) will be developed to address the identified issues. A Stakeholder Engagement Plan, including a grievance mechanism will need to be adopted by the participating municipalities. A specific institutional arrangement will be created to ensure that the project is duly implemented throughout the whole lifecycle in compliance with the EBRD's Environmental and Social Policy requirements, both the Company and the ultimate users of the solid waste equipment (the municipalities).

#### **Kvemo Kartli Solid Waste Project – EBRD;**

The project will finance the construction of an EU compliant regional sanitary landfill and relevant infrastructure in Marneuli municipality to serve the Participating Municipalities. The project will also include acquisition of vehicles, waste containers and other equipment for waste management activities. In addition, the project will support institutional development of the Company and the Participating Municipalities.

#### **Integrated Solid Waste Management in the Southern Caucasus (Georgia, Azerbaijan, Armenia) – European Commission**

The overall objective of the project is to contribute to a sustainable and environmentally sound Integrated Solid Waste Management (ISWM) in the Southern Caucasus that considers all stages of the solid waste management cycle (reduce, reuse, recycle and disposal). To this end, the set up of such a system is envisaged in a pilot municipality in each country (Georgia, Azerbaijan and Armenia). The projected activities include the closure of existing dump sites, the construction of new landfills according to the EU Landfill Directive (99/31/EC), the improvement of collection and transport and the introduction of recycling practices.

The ISWM systems will save resources and reduce greenhouse gas emissions, particularly through the avoidance of methane ('landfill gas') and allow for an efficient use of resources (recycling) and the use of waste to produce energy.

#### **Local Governance Programme South Caucasus – GIZ**

With GIZ's support, the Government of Georgia has prepared a national policy/strategy for regional development. The Local Governance Programme has provided strategic development advice to three regions and has involved the municipal and the national level as well as civil society and the private sector in this process. The strategies have been

adopted by the Cabinet and are now being implemented. The reforms supported by the GIZ programme are consistent with the EU's structural approach and are helping align the country with the EU.

The expertise of German local authorities has been put to good use in forging links between towns and cities in Germany and the South Caucasus within the Caucasus Cities' Network. Network members engage in regional cooperation on topics such as improving municipal services, local economic development, and management of solid waste and contaminated sites.

The Ministry of Environmental Protection and Natural Resources of Georgia and the **Office of the Swedish Radiation Safety** signed a grant agreement under which Sweden will help Georgia to develop a 15-year strategy for the management of radioactive waste and the plan for its implementation.

For this purpose under the agreement will be allocated 35 thousand euros. At the same time the Georgian government adopted a national strategy for radioactive waste management up to January 4, 2017.

The development strategy will take the Georgian and Swedish experts. They will study and analyze the situation in Georgia in connection with the management of radioactive waste, as far as it complies with the standard of the International Atomic Energy Agency and the EU. Then there are planned activities necessary for their safe disposal, processing and storage.

**EBRD** will allocate 12 million euros to finance the "Solid Waste Management Project". In particular, the project will be allocated a loan of EUR 10 million and two million euros in the form of a grant. The purpose of the project - improvement of solid waste management, which involves the purchase of vehicles and containers for the collection of solid waste. Containers and equipment for solid waste collection will be provided for 64 municipalities.

Integrated Solid Waste Management Project envisages improvement, a new regional landfill and the creation of waste transportation systems and enterprises for waste sorting recyclable in Kutaisi (West Georgia). The total cost of the project is 26 million euros, including 20 million euros - a loan **German Bank for Reconstruction (KfW)**, EUR 2 million in the form of a grant allocated **Neighbourhood Investment Fund**, and € 4 million of the local contribution. The full duration of the project is four years.

### 16.2.5 Public awareness, education and communication initiatives

Currently there are no data available.

### 16.2.6 Barriers and success factors for waste management performance

The results of the Clean Up Georgia – Raising of Public Awareness and Involvement in Solid Waste Management Improvement Project research identified a list of the barriers for the successful waste management strategy implementation. First of all, it is necessary to note that the existing practice in Georgia with regard to the management of solid domestic wastes does not correspond to the requirements of EU and is lagging far beyond the international standards. The issues connected with the management of municipal solid waste need to be resolved, particular attention should be paid to the awareness rising of general society and state employees in this field which is still very low until now; this is creating big obstacles to the introduction of modern methods for the management of solid domestic wastes in the country. The most problematic waste management issues in Georgia are:

- weak legislative base;
- insufficient budget;
- absence of management plans for the municipal solid waste;
- spontaneous and unsystematic disposal of the waste;
- non-qualified workforce in the field of the waste • obsolete equipment; • lack of containers;
- old methods and technologies for waste collection; • absence of waste survey; • absence of waste segregation;
- lack of waste recycling business;
- landfills (lack of qualified workforce; lack of adequate equipment; absence of waste inventory; absence of private landfills; existence of illegal, spontaneous landfills; absence of landfill infrastructure (fencing, guard, inner road, scales, other supportive facilities, etc);
- absence of environmental monitoring and control.

All above listed problems could be solved if in the field of municipal solid waste management there is formed united State Strategy, relevant legislation and the system of integrated, sustainable waste management system is introduced in the country where both general society and private sector would be involved transparently. All this is directly connected with finances, although the improvement of the field of municipal solid waste management would be followed exclusively with positive results, such as mitigated negative impact on the environment, elimination of spontaneous illegal landfills, lessened amount of wastes, improvement of human health and economic state, awareness and conscious raising of public, development of statistics of solid domestic wastes management and creation of data base which is so important for the issues of integration of the country into the EU.

### 16.3 Sources

- [1] Participatory Strategic Planning of Solid Waste Management in the Republic of Moldova, December 2012
  
- [2] Regional Development Programme of Georgia, 2015-2017
  
- [3] Waste Classification & Inventory Systems In South Caucasus Countries Draft Background Paper
  
- [4] National Environmental Action Programme of Georgia 2012 –2016
  
- [5] World Bank, May, 2016
  
- [6] Naturvernforbundet Norwegian Society for the Conservation of Nature
  
- [7] European Neighbourhood And Partnership Instrument – Shared Environmental Information System Georgia Country Report, October-December, 2011 Tbilisi, Georgia
  
- [8] Report On Municipal Solid Waste Management in Georgia, Clean Up Georgia, 2012

## 17. Comparison and evaluation of different waste management systems

The waste management situation and the development of the waste industry in post-socialist states, the “old” EU member states and the post-Soviet states in the past 30 years were explained in detail in the previous items. It is noticeable that the waste industry has developed totally different in those countries – not only with regard to procedures and operations but also with regard to the temporary development.

Hereinafter produced waste, treated waste, tipped waste, recycling, composting, incineration, the GDP and the unemployment rate of those countries will be compared and the differences evaluated.

It is especially important to mention beforehand that the available data is partly quite modest. Information from EU member states is easily available. Yet the information from post-Soviet states is fragmentary. Neither the research for country reports nor further efforts to determine the data were successful. Some country reports mention the problems in regard to available data (see also 12.2.2 and 13.2.2).

The countries Poland, Germany and Estonia will be regarded as post-socialist EU member states. As “old” EU member states are considered: Austria, Denmark and Italy. As post-Soviet states are regarded: Belorussia, Kazakhstan, Russia, Ukraine, Georgia and Moldavia.

Hereinafter the municipal waste generation, the total waste treatment and the types of waste treatment are depicted. Municipal waste is considered to be the waste collected through waste removal systems in private households or public institutions. It is equal with the notion of „collection of waste“. In case there is no waste removal systems the figures are estimated. The “total waste treatment” depicts the treatment of the overall collected waste. From this consideration unrecorded waste will be excluded. The informal sector is estimated to differ strongly. The treatment of waste differs in incineration, composting, recycling and tipping.

The following table 56 shows treatment types of waste. The data are given in kg per head. Table 55 shows the percentages of incineration, composting, recycling and landfilling of the collected waste.

Table 55: Amounts about waste treatment

	waste generated [per capita in kg]		total waste treatment [per capita in kg]		Landfill [per capita in kg]		Recycling [per capita in kg]		Composting [per capita in kg]		total incineration [per capita in kg]		GDP [per capita in €]		Unemployment rate [%]	
	1995	2014	1995	2014	1995	2014	1995	2014	1995	2014	1995	2014	1995	2015	1995	2014
	<b>Poland</b>	280	272	285	272	279	143	0	57	5	30	0	41	2.800	11.100	k.A
<b>Germany</b>	623	618	623	618	267	9	164	288	82	106	110	215	23.000	37.100	8,2	5
<b>Estonia</b>	371	357	370	303	368	23	0	95	2	17	0	169	2.000	15.600	k.A	7,4
<b>Italy</b>	454	488	468	455	422	154	16	127	6	80	24	94	15.100	26.900	11,2	12,7
<b>Austria</b>	437	566	480	547	205	23	203	144	118	176	54	206	23.100	39.400	4,2	5,6
<b>Denmark</b>	521	758	521	758	96	10	75	204	57	132	293	412	26.600	46.800	6,7	6,6
<b>Russia</b>	101	330	101	330	91	297	12	40	0	0	0	0	2526	22.170	9,4	5,3
<b>Kazakhstan</b>	140	200	k.A	k.A	k.A	k.A	k.A	k.A	k.A	k.A	k.A	k.A	1205	22.450	7,8	5,1
<b>Belarus</b>	143,5	421,7	k.A	k.A	k.A	k.A	k.A	k.A	k.A	k.A	k.A	k.A	1282	16.650	1,4	0,5
<b>Ukraine</b>	195	233,34	k.A	233,34	k.A	233,05	k.A	0,09	k.A	0	k.A	0,06	875	7.500	6,8	9,3
<b>Moldavia</b>	k.A	268	k.A.	k.A.	100%	268	0	0	0	0	0	0	888	4.700	7,4	3,9
<b>Georgia</b>	k.A	k.A	k.A.	k.A	100%	100%	0	0	0	0	0	0	1742	8.900	13,6	13,4
	[3]															
	[4]															
	[2]															
	[5]															



Table 56: Amounts of waste treatment in percent

	waste generated [per capita in kg]		Landfill [per capita in %]		Recycling [per capita in %]		Composting [per capita in %]		total incineration [per capita in k%]	
	1995	2014	1995	2014	1995	2014	1995	2014	1995	2014
<b>Poland</b>	280	272	99	52	0	21	1,8	11	0	15
<b>Germany</b>	623	618	42	1,5	26	46	13	17	17	34
<b>Estonia</b>	371	357	99	6	0	26	0,5	4,8	0	47
<b>Italy</b>	454	488	92	32	3,5	25	1,3	16	5	19
<b>Austria</b>	437	566	46	4	46	26	27	31	12	36
<b>Denmark</b>	521	758	18	1,3	14	26	10	17	56	54
<b>Russia</b>	101	330	90	90	10	10	k.A	k.A	k.A	k.A
<b>Georgia</b>	k.A	k.A	100	100	0	0	0	0	0	0
<b>Moldava</b>	k.A	268	100	100	0	0	0	0	0	0
<b>Ukraine</b>	195	268	99	99	0	0	0	0	0	0

### 17.1 Produced waste

The following figure 65 depicts the produced waste per head in 1995 and 2014.

In 1995 there was more waste accumulated in post-socialist countries than in 2014. Until 2014 a small decrease can be measured. For example, Germany produced in 1995 623 kg of waste per head, in 2014 it were 618 kg per head.

The “old” EU member states produce significantly less waste in 1995 than in 2014. The figures increased especially for Denmark. Whereas there were only 521 kg of waste per head in 1995, Danes produced 758 kg of waste in 2014.

Also the post-Soviet states produced less waste in 1995 than in 2014. The difference is biggest in Belorussia – the population produced in 1995 144 kg of waste per head, in 2014 it were 421 kg waste per head.

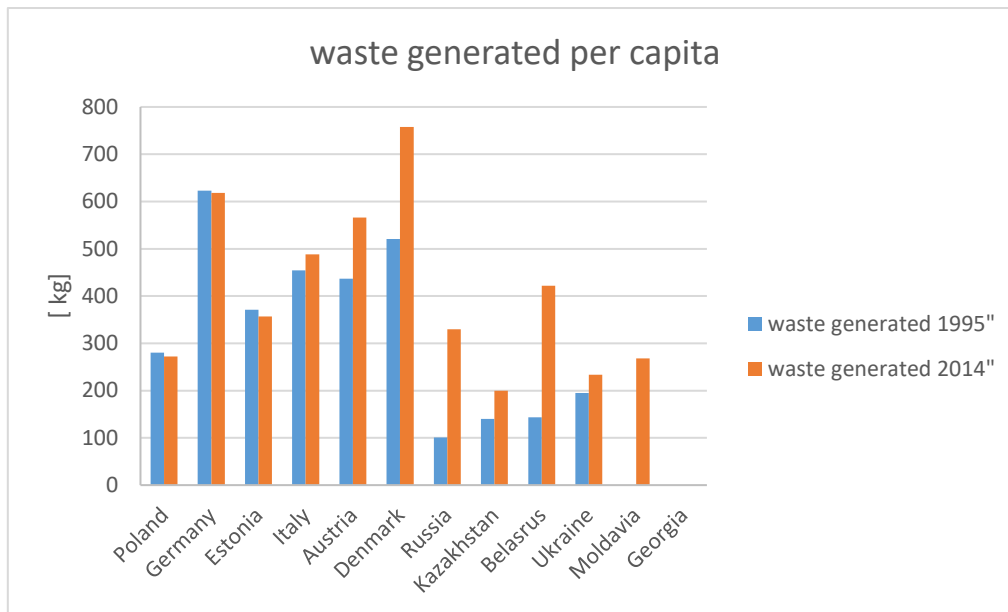


figure 65: waste generated per capita in 1995 and 2014

The increase is explainable through the development of industries and the improved living conditions of the respective populations. Due to a growing production, the ensuing supply of goods and the improved liquidity the consumption behaviour of people is changed. Relating to that there is also a rise in waste production.

One has to bear in mind that the figure is depicting merely the amount of collected waste. Any illegally collected or dumped waste cannot be taken into consideration and constitute unreported amounts.

## 17.2 Treated waste

The following figure 66 depicts the waste treatment per head in 1995 and 2014. For the amount of treated waste in post-Soviet states there is currently no reliable data. One source states that Russia tips circa 90 per cent of all waste and treats the remaining 10 per cent. Accordingly there is the assumption for Russia that all produced waste has been treated. It is further assumed that the 10 per cent of other waste have been recycled. These 10 per cent could, for example, be metals. Yet as there are only estimations for Russia, these will be used as a representative example for the post-Soviet states – however, there may be actually differences between the named countries and Russia.

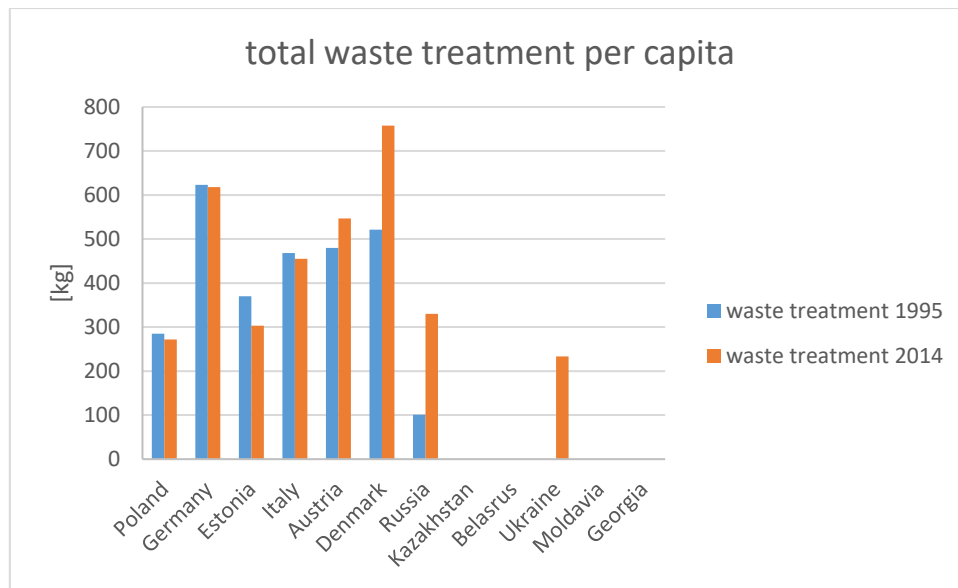


figure 66: total waste treatment per capita in 1995 and 2014

### 17.3 Landfilling

Figure 68 contains the tipped waste per head for 1995 and 2014. However, the figure falsifies the actual results as it depicts the amount of tipped waste per head in relation to the overall produced waste. One has to bear in mind that, for example, Russia produces less waste than Denmark.

In the post-socialist EU member states Estonia and Poland tipped 99 per cent of their waste in 1995 and Germany tipped 42 per cent of their waste in 1995. Until 2014, Poland reduced this amount down to 50 per cent. The reductions were higher in Estonia and Germany – Estonia tipped only 6 per cent and Germany tipped 1,5 per cent of the overall produced waste. There exist big differences between the “old” EU member states. Italy tipped in 1995 92 per cent of its waste, Austria tipped 46 per cent and Denmark tipped 18 per cent of its waste. Until 2014 there were reductions as follows: Italy down to 32 per cent, Austria down to 4 per cent and Denmark down to 1,3 per cent.

For the post-Soviet states, data generation was only possible for Georgia, Moldavia, Russia and Ukraine. These countries tip a similar amount of waste. Russia tips circa 90 per cent of its waste. [4] If the waste accumulation is 330 kg per head, this amounts to 297 kg of tipped waste per head. Georgia and Moldavia do not treat their waste, thus all

waste is tipped. The Ukrainian figures tell that currently 233, 05 kg waste is tipped per head.

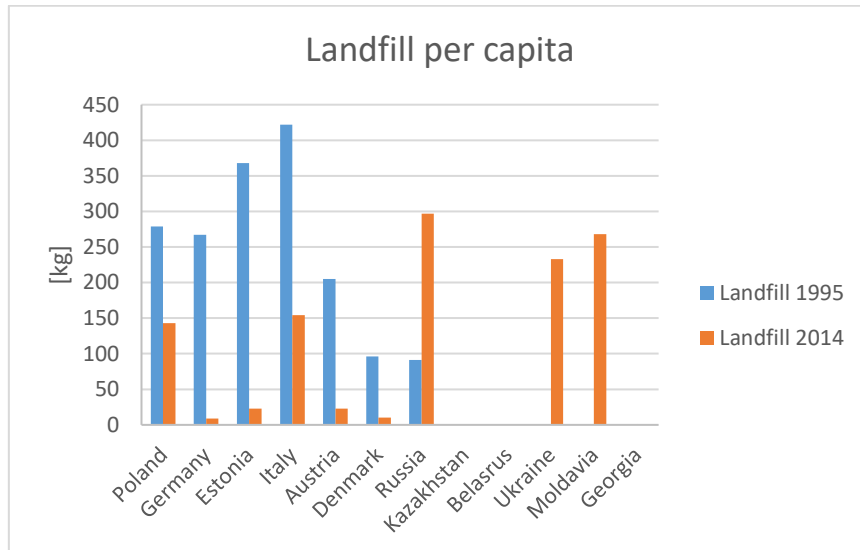


figure 67: landfill per capita in 1995 and 2014

#### 17.4 Recycling

Figure 69 indicates the amount of recycling per head in 1995 and 2014. After tipping, most of the produced waste goes through the procedure of material recycling. The post-Soviet countries could not provide data for all countries. Statements can only be made about the Ukraine, Russia, Moldavia and Georgia.

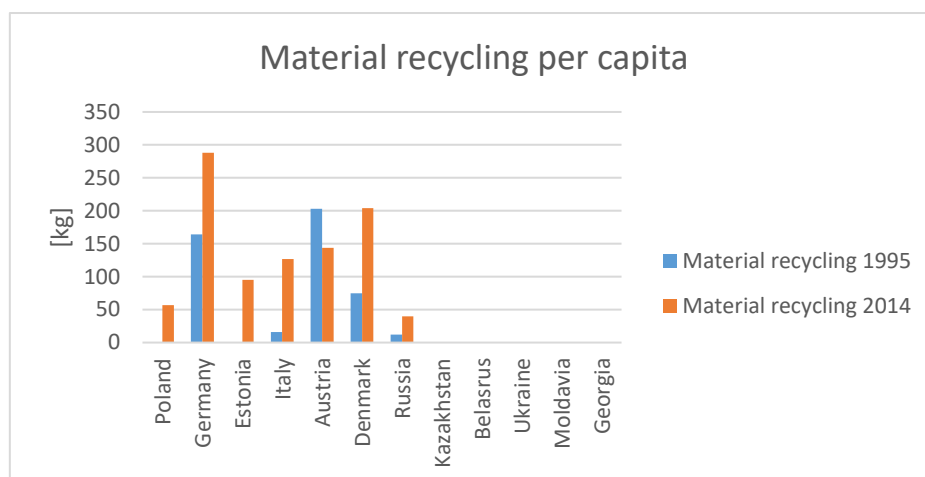


figure 68: material recycling per capita in 1995 and 2014

In 1995 there was no material recycling in Poland and Estonia. Compared to that, Germany recycled in 1995 26 per cent and in 2014 46 per cent of its overall produced waste. Around 50 per cent of waste is recycled in Germany and flows as secondary raw materials into the production cycle.

From the “old” EU member states Austria is most interesting as the recycling rate was 46 per cent in 1995 and after that followed a decline down to 25 per cent in 2014. This can be explained by the fact that Austria uses more of its municipal solid waste to gain energy during incineration. Denmark and Italy show reversed trends, whereas Italy’s recycling increased from 3,5 per cent in 1995 to 26 per cent in 2014 and Denmark increased from 14 per cent to 26 per cent.

Russia recycled only circa 10 per cent of the overall generated waste. [4] Georgia and Moldavia did not manage any kind of recycling in the past years. No statements can be made about Kazakhstan and Belorussia, as data lacks for both countries. The Ukraine recycled a very small part of its collected waste, the recycling rate is here circa 0,09 kg per head.

### 17.5 Composting

The following figure 69 indicates the amount of composted waste per head in 1995 and 2014. A comparison ensues here merely between the “old” EU member states and the post-socialist EU states. In post-Soviet countries like Georgia, Ukraine and Moldavia

there was no composting. For Kazakhstan, Russia and Belorussia there are no figures available.

At first the figure shows that the “old” EU member states compost much more than the post-socialist states.

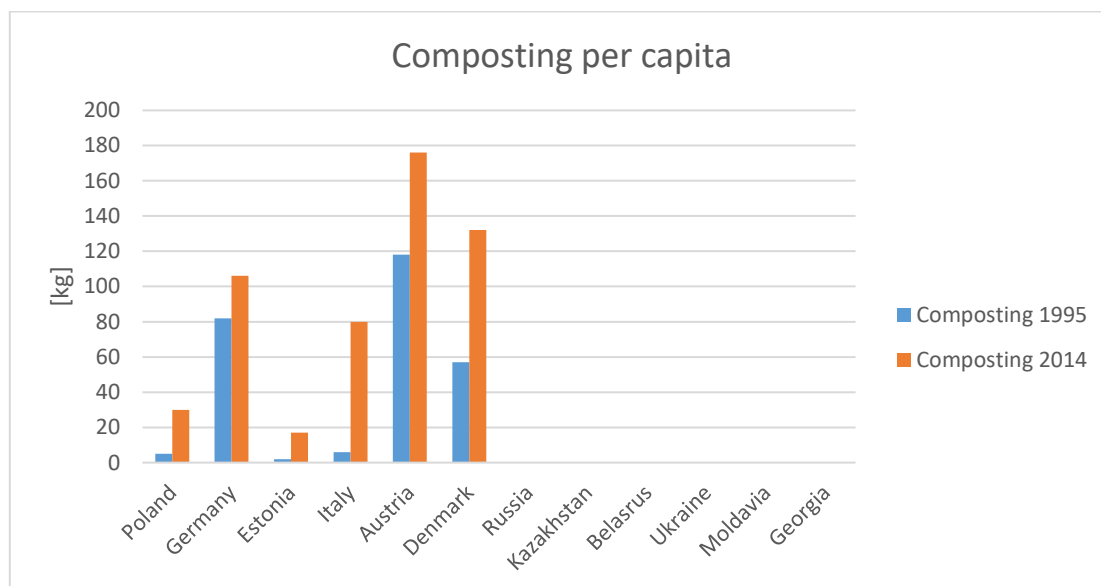


figure 69: composting per capita in 1995 and 2014

As of the post-socialist EU member states, Germany composted most of its waste both in 1995 and 2014. In 1995, 13 per cent and in 2014 17 per cent of the overall waste were composted in Germany. Poland and Estonia show a significant increase – especially Poland went from 1,8 per cent in 1995 to 11 per cent in 2014. Estonia composted only 0,5 per cent (1995) and 2,8 per cent (2014) of its overall waste. In 1995 neither the state-of-the-art nor the capacities were sufficient in order to build composting plants or provide the required capacities. Due to these reasons, significantly more waste was treated with other methods. The population’s own efforts to compost in their own garden are not included in the analysis, although they could raise the proportional amount of composting significantly as green waste and garden waste amount to a considerable amount of waste.

Compared to the other “old” EU member states Austria composts most of its overall produced waste. The figures rose from 27 per cent in 1995 to 31 per cent in 2014. In

Denmark, composting rose during the same period from 10 per cent to 17 per cent and in Italy it rose from 1,3 per cent to 16,4 per cent.

## 17.6 Incineration

Figure 71 depicts the waste incineration per head in 1995 and 2014. There was no data generated in the post-Soviet countries Russia, Kazakhstan and Belorussia. Statements can only be made about the Ukraine, Moldavia and Georgia. For the post-Soviet EU member states there is merely a comparable figure for Germany in 1995, as there existed no incineration plants in Poland and Estonia. In 1995, Germany treated only 17 per cent and in 2014 34 per cent of the overall collected waste in incineration plants. Energy for heating and electricity is gained from the incineration of municipal solid waste. Estonia seized in 2014 still 47 per cent of waste per head as an energetic resource through incineration. Due to the energy gain, incineration has a high status in Estonia. Poland treated in 2014 15 per cent of the overall produced waste per head in incineration plants. There are few Polish incineration plants thus the waste has to be treated otherwise.

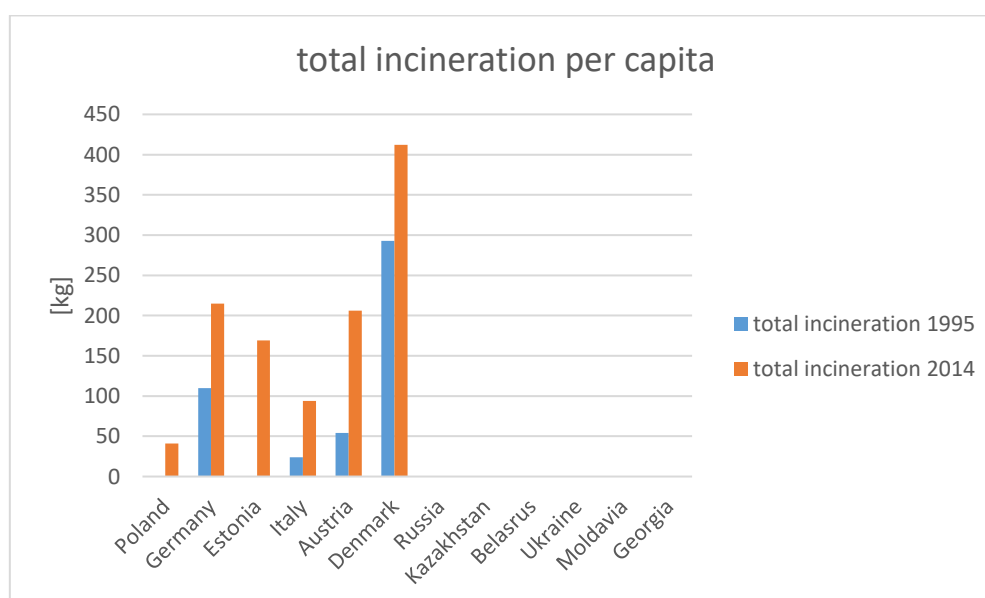


figure 70: total incineration per capita in 1995 and 2014

What is interesting about the "old" EU member states is that Denmark incinerates more waste than Austria or Italy. In 1995, Denmark treated 56 per cent and in 2014 54 per cent

of the overall produced waste per head with incineration. Yet here is the energy gain paramount as Denmark has a high energy consumption. In both Italy and Austria the amount of incinerated waste has risen significantly from 1995 until 2014. This could be due to the state-of-art, as today there are more and newer plants built. Italy treated in 1995 5 per cent and in 2014 19 per cent of its total waste with incineration. It was a little more in Austria: In 1995, 12 per cent and in 2014 36 per cent of the overall produced waste was incinerated. As of the post-Soviet states, only the Ukraine treated its waste with incineration. The figures amount here to 0,06 kg per head. In Moldavia and Georgia there is no incineration of waste until the present day.

### 17.7 GDP and unemployment rate

In the waste industry, social aspects and differences can be noticed. Among others this affects the gross domestic product (GDP) and the unemployment rate. The following figure 71 and figure 72 depict the differences concerning GDP and unemployment in the post-socialist EU states, the "old" EU member states and the post-Soviet states. The social and financial differences condense in the willingness of citizens to introduce new waste industrial systems.

The GDP summarises the value of all goods and services of a particular amount of time, which were generated in a people's republic. It is of importance to check whether the economic effort is achieved by a national or foreign citizen. [1]

Apart from that the GDP compares also often the prosperity of a nation. Yet it remains problematic that the GDP as an instrument to measure prosperity does not indicate whether the government's funds are invested wisely. Environmental exploitation and waste of natural resources may have a positive effect on the economy and raise the GDP. Statistically, this would be an increase in the GDP. Apart from that, illegal employment, barter, shadow economy and subsistence economy cannot be ignored as they form the livelihood for many poorer citizens. Yet these "industries" are not taken into the GDP's figures.

Furthermore the GDP serves as an indicator for economic growth. It is indicated through the rise of the GDP. An increase of economic power is based on an increase in productivity which is influenced by:



- physical capacity (machines),
- human capacity (employees),
- natural resources
- technical knowledge

The ensuing figure 71 depicts the GDP per head in euro. figure 71 shows that the GDP per head was lower in 1995 than in 2014. In addition, the GDP in the “old” EU member states and the post-socialist countries was significantly higher than in the post-Soviet states.

In the post-socialist EU states the GDP of 1995 was clearly below the GDP average in 2014. Germany’s GDP amounted to 23.000 euro per head in 1995 and to 37.100 euro per head in 2014.

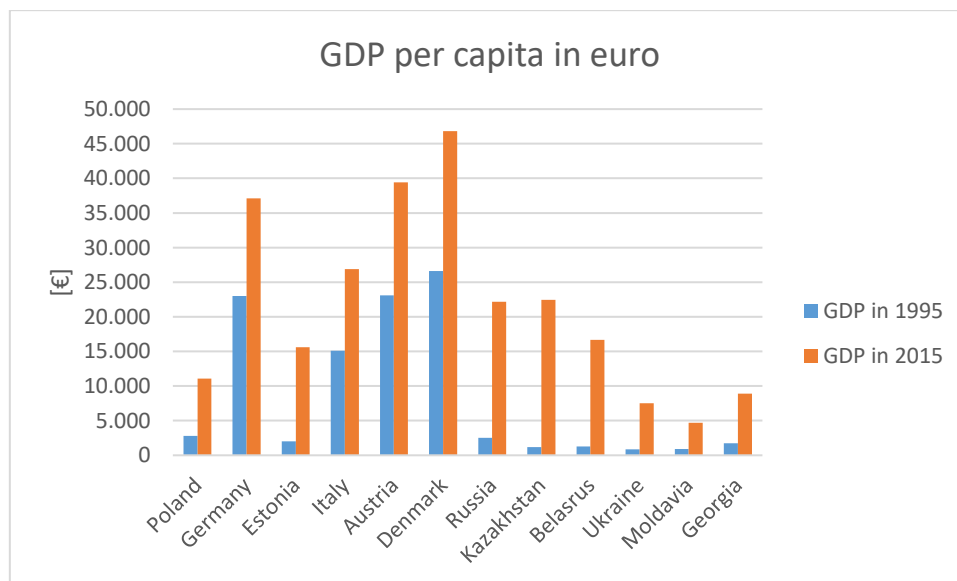


figure 71: GDP per capita in 1995 and 2015

The GDP of the “old” EU member states is clearly above the overall average of the other compared countries. In 1995, Denmark’s GDP marked 26.600 euro per head and in 2014 it were 46.800 euro per head.

The GDP of post-Soviet states is distinctively below the average of the EU member states. The Ukraine had the lowest GDP in 1995 – only 875 euro per head. In 2014 the

Ukrainian GDP rose to 7.500 euro per head. The lowest GDP was in Moldavia – 4.700 euro per head.

From the figure emerges that countries with a longer EU membership have a clearly higher GDP. Examples are Denmark, Austria, Italy and Germany. Poland and Estonia joined the EU later.

Unemployment is the lack of employment opportunities for parts of the population that is both able to work and seeking work. In many countries around the world, unemployment is one of the biggest macroeconomic challenges, as it causes high social and ecological costs. [2]

Figure 73 illustrates the unemployment rate in 1995 and 2014. The unemployment rate is higher in 1995 than in 2014 in post-socialist countries. 8, 2 per cent of the German population fit for work was unemployed in 1995. Until 2014 the unemployment rate sank down to 5,0 per cent.

In the “old” EU member states a similar tendency prevails. Italy has the highest unemployment rate: it was 11, 2 per cent in 1995 and 12, 7 per cent in 2014. The Danish unemployment rate is, however, identical for 1995 and 2014 – 6, 6 per cent.

For the post-Soviet countries, the unemployment rate of 2006 and 2014 are compared as no earlier data is known. There was a higher unemployment rate in 2006 than in 2014. Georgia had the highest unemployment rate: in 2006 it was 13, 6 per cent and in 2014 it was 13, 4 per cent. The biggest decrease of unemployment happened in Moldavia – from 7, 4 per cent in 2006 to 3, 9 per cent in 2014.

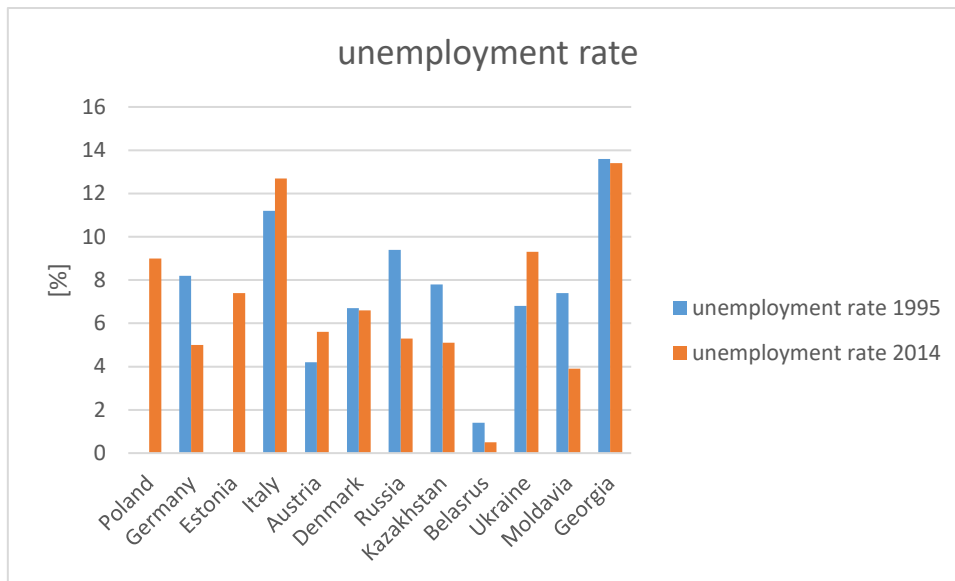


figure 72: unemployment rate in percent in 1995 and 2014

The figures for unemployment are closely related to the financial concerns of the population. The more unemployed people there are in one country, the more people struggle with financial problems and existential fears. This is a factor that influences the population's willingness to implement and accept a new waste industrial system.

The relationship between unemployment and GDP or the economic growth is explained through Okun's Law. Arthur Okun first described the correlation between the two aspects based on his empirical observations. His Law states that an increase of the unemployment rate by 1 per cent cost 2, 5, per cent of economic growth. However, also a reversed scenario can be observed: It takes 2, 5 per cent of economic growth in order to decrease unemployment by 1 per cent. One has to bear in mind that the exact percentage varies depending on the type of national economy and has to be adjusted anew.

To achieve a decrease in unemployment by boosting the economic growth it needs a so-called "employment surge". This surge characterises a growth rate that is required as a minimum in order to secure current employment. Among other factors, the extent of the employment surge is defined by technological progress – because the higher the productivity, the less human manpower is necessary in order to achieve the same GDP.

The ensuing figure 73 depicts the dependency of the GDP per head and the unemployment rate in 1995 and 2014.

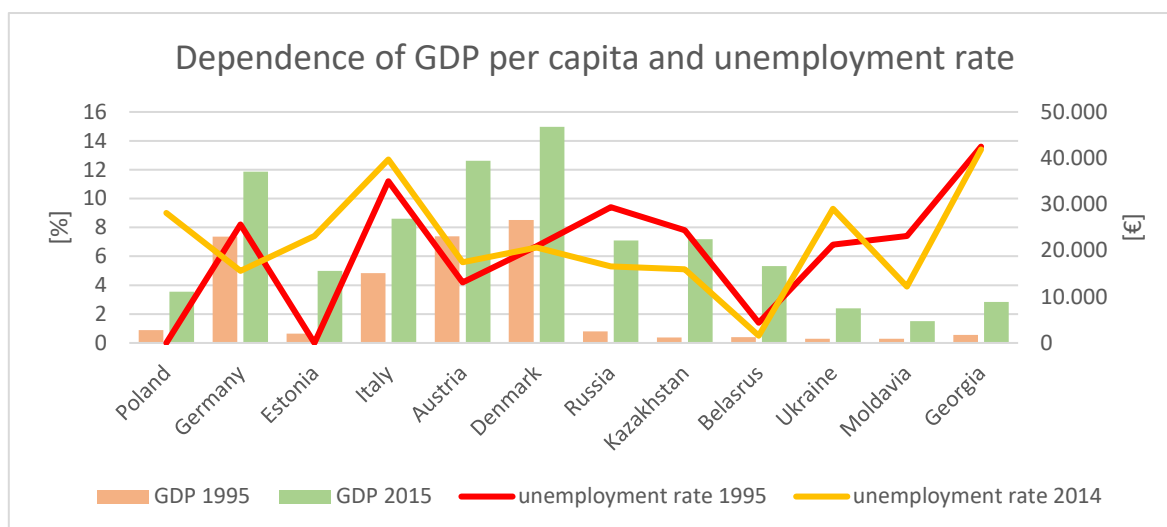


figure 73: Dependence of GDP per capita and unemployment rate

The figure illustrates the employment surge of 1995 and 2014. In 1995, Estonia, Germany, Austria and Denmark had a low unemployment rate and a sufficiently high economic growth. This means, the employment surge was successful. The economic growth is sufficient to curb or decrease unemployment. In 2014 this applies for Germany, Austria, Denmark, Russia, Kazakhstan and Belorussia. In 1995 the following countries had no successful employment surge: Georgia, Moldavia, Ukraine, Belorussia, Kazakhstan, Russia and Italy. As a consequence, unemployment rates went up. In 2014 this applied to Poland, Estonia, Italy, Ukraine, Moldavia and Georgia.

Germany, Austria and Denmark achieved an employment surge in 1995 and 2014. On the one hand, these countries show a constant social and financial standard and on the other hand a constantly positive development of the waste industry. It is to be speculated whether and how these factors are related to one another. However, based on that assumption, a broader support from the population for concerns of the waste industry is visible. Apart from that the economic and political interest pursues a constant improvement of the waste industry and the related improvements for the environment. Neither Georgia, nor Moldavia, Ukraine or Italy had a successful employment surge in 1995 and 2014. This is another hint that poor social and financial standards are related to a lack of willingness and opportunities for citizens, politics and the economy to contribute to change and improvement of the waste industry and environment.

### 17.8 Sources

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## 18. Summary

Figure 74 and figure 75 summarises the treatment of the overall generated waste for 1995 and 2014 expressed as percentage. In 1995, the focus was still clearly on landfilling but this changed until 2014, when the focus was put on different treatment procedures. In 1995, the waste of post-Soviet states and post-socialist EU member states were mostly untreated and simply tipped. Denmark and Austria were the exceptions as they had their focus on recycling and incineration.

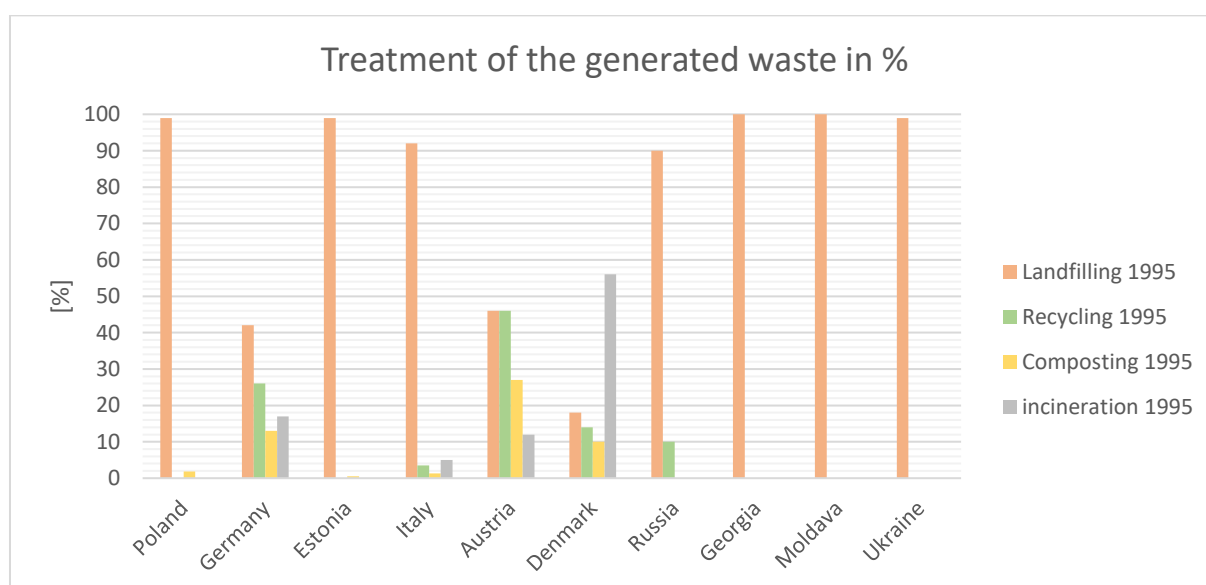


figure 74: Treatment of generated waste in 1995

Figure 74 and figure 75 depicts clearly a change from landfilling to recycling over the past years. All countries show an enormous decline in landfilling. Only Poland still tips 50 per cent of its waste. With mere 1, 5 per cent Germany is in the lead, yet also Estonia, Austria and Denmark managed to tip less than 10 per cent of their generated waste.

Recycling has gained great significance and Germany recycles already 46 per cent of the overall municipal solid waste. Other countries increased their recycling by minimum 20 per cent. Also the incineration for energy gain has increased significantly until 2014. Poland and Estonia picked up incineration in the first place – compared to 1995. Denmark gains energy from 54 per cent of its municipal solid waste. There is also an increase in

composting of biodegradable waste. In 1995 only Germany, Austria and Denmark composted more than 10 per cent of the overall generated waste; in 2014 each of the named countries had a least one composting plant. Austria composts 31 per cent of its overall generated waste. The biggest change can be seen in landfilling as figure 74 illustrates the enormous decline in landfilling. Whereas Poland, Estonia and Italy tipped still 90 per cent of their waste in 1995 and Germany and Austria tipped roughly 50 per cent of their overall generated waste in 1995, this amount has almost halved until 2014. Poland tips only 50 per cent and Italy merely 30 per cent of its waste in 2014. Other countries show even lower rates – for example, Denmark and Germany tip only 1, 5 per cent of their waste.

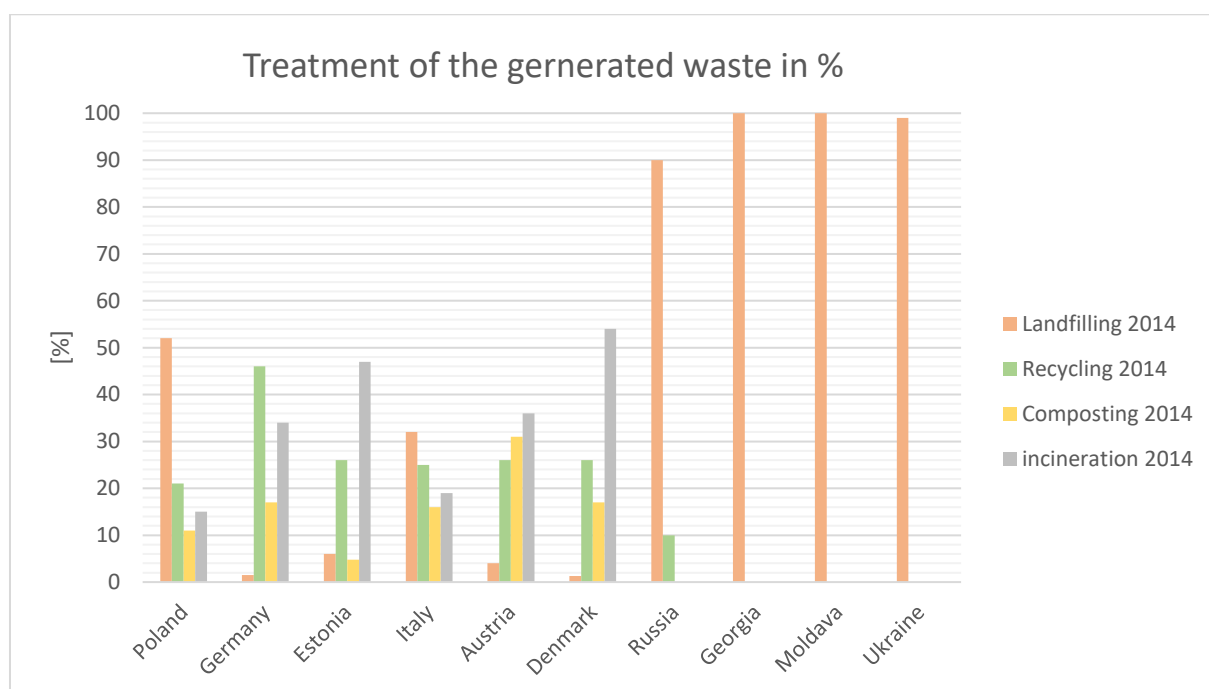


figure 75: Treatment of generated waste in 2014

For the post-Soviet states, Russia, Ukraine, Georgia and Moldavia are representative examples. Moldavia and Georgia do not treat their waste at all. The collected waste is tipped either on authorised landfills or illegal dumps. The Ukraine tips 99 per cent of its waste. The remaining 1 per cent are incinerated or recycled materially. Russia tips circa 90 per cent of their generated waste. The remaining 10 per cent are treated otherwise. It is estimated that these 10 per cent concern material recycling, for example of metals. For the other post-Soviet states no data was available – thus it can only be estimated

that the figures are similar to Russia, Georgia, Moldavia and the Ukraine. In order to improve the waste industry it is necessary to publish data on waste industrial processes. Apart from that there ought to be more incentives for the population to collect waste separately. Furthermore, it will be necessary to lower the activities of the informal sector. Investments, increased employment in the waste industry and education events for the overall population could improve the situation. The waste system of the EU could be transferred to the post-Soviet states as it promises a palpable improvement as already figure 74 shows. With an implementation of the EU requirements the waste industry turns away from mere landfilling to recycling, composting and incineration for energy gain.